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THESIS

THE USE OF AIR POWER FOR MARITIME HOMELAND DEFENSE

by

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December 2006

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This thesis uses a capabilities-based methodology to determine what gaps exist in the military's current ability to perform maritime homeland defense against unconventional and asymmetric opponents. This approach reveals that including joint air assets as part of the maritime defense force can significantly enhance protection of the homeland. In the short term, the military can use air power from each of the services for long-range maritime surveillance and interdiction. Additionally, using aircraft for maritime defense combat air patrol provides an effective and efficient last line of defense. Over the longer term, an investment in new technologies including non-lethal weapons and persistent surveillance platforms can make the joint force an even more effective guarantor of U.S. maritime security.

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THE USE OF AIR POWER FOR MARITIME HOMELAND DEFENSE

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ABSTRACT

This thesis uses a capabilities-based methodology to determine what gaps exist in the military's current ability to perform maritime homeland defense against unconventional and asymmetric opponents. This approach reveals that including joint air assets as part of the maritime defense force can significantly enhance protection of the homeland. In the short term, the military can use air power from each of the services for long-range maritime surveillance and interdiction. Additionally, using aircraft for maritime defense combat air patrol provides an effective and efficient last line of defense. Over the longer term, an investment in new technologies including non-lethal weapons and persistent surveillance platforms can make the joint force an even more effective guarantor of U.S. maritime security.

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I. THE MARITIME DEFENSE PROBLEM

A. INTRODUCTION

On 16 April 1947, an explosion shattered Texas City's morning calm. Moored at the city dock, the French-owned merchant vessel SS *Grandcamp* caught fire in the early morning hours. Although the city fire department responded en masse, their efforts were in vain. At 9:12 a.m., the vessel's deadly cargo of ammonium nitrate fertilizer exploded with tremendous force. The resultant blast destroyed the dock, a nearby chemical company, and heavily damaged the remainder of the city's industrial area. "Fragments of iron, parts of the ship's cargo, and dock equipment were hurled into businesses, houses, and public buildings."[1] Even worse, the explosion ignited another nearby vessel, the *High Flyer*, also carrying ammonium nitrate. Most of Texas City's firefighting equipment was destroyed by the *Grandcamp* explosion. With no means to subdue the growing inferno, the *High Flyer* continued to burn and eventually detonated at 1:10 a.m. the following morning.[2] The two explosions killed over 575 people and injured 3,500. Property damage from the blasts totaled over $700 million in 1997 dollars.[3]

The death and destruction caused by the accidental blasts of the *Grandcamp* and *High Flyer* bring into sharp relief the potential vulnerability of America to non-traditional means of maritime attack. Enemies of the United States could cause a massive carnage and untold economic damage either by exploding a ship laden with combustible materials or by using a vessel to deliver a weapon of mass destruction (WMD). As a 2003 U.S. Department of Transportation study found, the detonation of a nuclear weapon in a major

[1] Texas State Historical Association, "Texas City Disaster," *Handbook of Texas Online* (Texas State Historical Association and the University of Texas: 6 June 2001), available from http://www.tsha.utexas.edu/ handbook/online/articles/TT/lyt1.html (accessed 14 March 2006).

[2] Ibid.

[3] *New York Times*, "50 Years Later, Texas Town Recalls Horrors of Deadly Blast," East Coast late edition, 16 April 1997), A12.

U.S. port could cost between "hundreds of billions to trillions" of dollars.[4] These staggering potential costs from asymmetric enemy attacks elevate the maritime homeland defense mission to critical importance.

Conducting effective maritime homeland defense is a difficult and complex mission. In particular, the size of the maritime domain and the volume of traffic through it make detecting unconventional attacks on the U.S. homeland problematic. This thesis will argue that while naval surface and sub-surface forces are indispensable to the maritime homeland defense mission, augmenting these forces with air power—regardless of service affiliation—can significantly enhance U.S. maritime defense. Using a capabilities-based planning construct, this thesis will show that significant gaps currently exist between U.S. maritime defense needs and capabilities. It will argue that using the speed, range, and flexibility of air power for maritime defense reduces these gaps significantly. Still, adopting innovative concepts of operation that leverage current capabilities goes only so far. Accordingly, this thesis will also identify areas where technological innovations are required to make the joint force an even more effective guarantor of U.S. maritime security. To lay the foundation for these arguments, an examination of the contemporary maritime defense environment is first necessary.

B. THE CONTEMPORARY MARITIME DEFENSE ENVIRONMENT

In most previous conflicts, conventional forces from both sides waged a largely symmetric war. In contrast, the *National Strategy for Combating Terrorism* correctly notes that today's enemy "is a flexible, transnational network structure, enabled by modern technology and characterized by loose interconnectivity both within and between groups."[5] This networked structure gives terrorists certain operational characteristics.[6] Not only can networked organizations be highly efficient, but "[t]hey know how to swarm and disperse, penetrate and disrupt, connect and disconnect, as well as elude and

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[4] Clark C. Abt, *The Economic Impact of Nuclear terrorist Attacks on Freight Transport Systems in an Age of Seaport Vulnerability* (Cambridge, MA: Abt Associates, 30 April 2003), available from http://abtassociates.com/ reports/ES-Economic_Impact_of_Nuclear_Terrorist_Attacks.pdf (accessed 14 March 2006).

[5] The White House, *National Strategy for Combating Terrorism* (Washington, D.C: The White House, February 2003), 10.

[6] See Marc Sageman, *Understanding Terror Networks* (Philadelphia: University of Pennsylvania Press, 2004), 170, for a discussion of al Qaeda's networked structure.

evade."[7] The 9/11 attacks demonstrated the potential power of this networked way of war. On that day, "transnational terrorists, organized in widely dispersed, networked nodes, swarm[e]d together swiftly, on cue, then pulse[d] to attack simultaneously."[8]

While terrorists used aircraft to attack on 9/11, adversaries could easily adapt a networked mode of attack to the maritime domain. This maritime environment is an appealing medium of attack for three primary reasons. First, the vastness of the maritime domain protects the attacker from detection. Its sheer size makes it difficult to locate an attacker. To put this problem in perspective, the U.S. has over 95,000 miles of shoreline, over 1000 harbor channels, and more than 300 ports it needs to protect.[9] Additionally, the U.S. Coast Guard polices 3.5 million square miles of ocean area performing its maritime security mission.[10] This massive area includes the U.S. economic exclusion zone, which extends 200 miles offshore and is home to vital natural resources.

Second, the volume of traffic in the maritime domain insulates attackers from detection. Defenders must be able to identify attackers amidst a backdrop littered with commercial traffic. According to the United Nations Conference on Trade and Development, over 46,000 vessels carried 5.8 billion tons of goods in 2001.[11] Annually, the U.S. marine transportation system moves more than 2 billion tons of domestic and international freight, imports 3.3 billion barrels of oil, transports 134 million passengers by ferry, and hosts more than 5 million cruise ship passengers.[12] In 2003 approximately 6,000 vessels made nearly 60,000 stops in U.S. ports.[13] Each day over 200 commercial

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[7] John Arquilla and David Ronfeldt, "The Underside of Netwar," *Review - Institute of Public Affairs* 54, iss. 4 (December 2002), 3.

[8] Ibid., 3.

[9] U.S. Department of Transportation, *An Assessment of the U.S. Marine Transportation System: A Report to Congress* (Washington, D.C: U.S. Department of Transportation, September 1999), 8, available from http://www.marad.dot.gov/publications/MTSreport/mtsfinal.pdf (accessed 16 March 2006).

[10] Maryann Lawlor, "Maritime Defense Undergoes All-hands Evolution," *Signal* 58, no. 3 (Nov 2003), 54.

[11] Ophir Falk and Yaron Schwartz, "Terror at Sea: The Maritime Threat," online article (Herzliya, Israel: The Institute for Counterterrorism at the Interdisciplinary Center Herzliya, 25 April 2005), available from http://www.ict.org.il/ articles/articledet.cfm?articleid=532 (accessed 16 March 2006).

[12] U.S. Department of Transportation, *An Assessment of the U.S. Marine Transportation System*, 8.

[13] John F. Fritelli, *Port and Maritime Security: Background and Issues for Congress*, CRS Report for Congress, RL 31733 (Washington, D.C: Library of Congress, updated 27 May 2005), 2.

vessels and 21,000 containers arrive at 185 U.S. deepwater ports.[14] Even the relatively small port at Texas City, rebuilt following the *Grandcamp* and *High Flyer* explosions, hosts 22 vessels and 60 million tons of cargo every day.[15] This background noise affords attackers a degree of anonymity that protects them from detection.

Finally, the maritime medium provides ready access to several high impact target sets. The U.S. maritime transportation system consists of more than "25,000 miles of inland, intracoastal, and coastal waterways . . . with more than 3,700 terminals that handle passenger and cargo movements. The waterways and ports link to 152,000 miles of rail, 460,000 miles of pipelines, and 45,000 miles of interstate highways."[16] Major ports abut major cities and associated infrastructure. The Department of Transportation found that in certain scenarios, maritime attacks could result in as many as one million deaths and direct property damage could reach $500 billion. Furthermore, attacks via the maritime domain have the potential to ravage world-wide trade and wreck the world economy. The costs of the initial trade disruption from an attack on a port could reach as high as $200 billion, with indirect economic costs reaching up to $1.4 trillion.[17]

Given this lucrative target set, the United States faces a wide array of potential attack methods from both state and non-state actors. The most commonly discussed methods of attack fall into four main categories: using a commercial vessel as a launch platform, using a commercial vessel as a weapon delivery system, using a commercial vessel as a weapon, and maritime infiltration of weapons or personnel.[18]

1. Using a Commercial Vessel as a Launch Platform

Conventional U.S. naval superiority could lead attackers to disguise their attack by launching weapons such as cruise missiles from military or commercial vessels.[19]

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[14] Guy Thomas, "A Maritime Traffic-Tracking System: Cornerstone of Maritime Homeland Defense," *Naval War College Review* 56, no. 4 (Autumn 2003), 139.

[15] Thomas, 139.

[16] U.S. Department of Transportation, *An Assessment of the U.S. Marine Transportation System*, 8.

[17] Abt, 4.

[18] U.S. Department of Defense, *Strategy for Homeland Defense and Civil Support* (Washington, D.C: U.S. Department of Defense, June 2005), 16, and U.S. Department of Homeland Security, *The National Strategy for Maritime Security* (Washington, D.C: Department of Homeland Security, September 2005), 3-5.

[19] U.S. Department of Defense, *Strategy for Homeland Defense and Civil Support*, 16.

Although adversaries could elect to use other weapons, the Congressional Research Service (CRS) has found that nation-states may acquire cruise missiles "as a cost effective means of 'leveling the playing field' against more advanced militaries."[20] Additionally, the CRS argues that cruise missiles are appealing to authoritarian regimes because they provide a higher degree of control: cruise missiles "are incapable of desertion."[21] Non-state groups might be inclined to use cruise missiles as they comport with their preferences for using cheap and easily accessible weapons and technologies."[22] In 2002, then-director of the Central Intelligence Agency George Tenet stated that "[b]y the end of the decade, LACMs [land attack cruise missiles] could pose a serious threat to not only our deployed forces, but possibly even the US mainland."[23] According to the National Intelligence Council, by 2015 the United States can expect cruise missiles to be "capable of delivering WMD [weapons of mass destruction] or conventional payloads" against fixed targets. "Major air and sea ports, logistics bases and facilities, troop concentrations, and fixed communications nodes increasingly will be at risk."[24]

Once state or non-state actors make the decision to acquire cruise missiles, they will have little difficulty obtaining them.[25] Proliferation is difficult to monitor, since cruise missile production utilizes many commercially available aviation technologies. As the CRS found:

> Missile airframes, navigation systems, jet engines, satellite maps, and mission planning computers and software all can be purchased on the

[20] Christopher Bolkcom, Congressional Research Service, "Statement before the Senate Governmental Affairs Committee, Subcommittee on International Security, Proliferation, and Federal Services, Hearing on Cruise Missile Proliferation," 11 June 2002, 2, available from http://www.senate.gov/~gov_affairs/061102bolkcom.pdf (accessed 17 March 2006).

[21] Ibid.

[22] Ibid., 1.

[23] George J. Tenet, "Worldwide Threat - Converging Dangers in a Post 9/11 World," Testimony of the Director of Central Intelligence before the Senate Armed Services Committee, 19 March 2002, available from http://www.cia.gov/cia/public_affairs/speeches/2002/senate_select_hearing_03192002.html (accessed 17 March 2006).

[24] National Intelligence Council, Central Intelligence Agency, *Global Trends 2015: A Dialogue About the Future with Non-government Experts* (Washington, D.C: Central Intelligence Agency, December 2000), 60, available from http://www.odci.gov/nic/PDF_GIF_global/globaltrend2015.pdf (accessed 17 March 2006).

[25] Some argue terrorists would have difficulty acquiring and employing cruise missiles against the United States. See R.B. Watts, "Fight Them Forward," *Strategic Insights* IV, iss. 7 (July 2005), available from http://www.ccc.nps.navy.mil/si/2005/Jul/wattsJul05.pdf (accessed 17 March 2006).

> commercial market. Cruise missile technology "hides in plain sight" – making it difficult to identify a military program. At the same time, commercial availability generally means relatively low-cost weapons for many nations and, potentially, non-state actors.[26]

Furthermore, according to a Center for Defense Information report, over 80,000 cruise missiles of 75 different types are currently deployed in at least 81 countries. Although most of these are short range systems with a range of 100 km or less, "a ship-launched 100 km missile . . . could still reach the homeland."[27] Once launched, the small size and low altitude of cruise missiles makes them difficult to detect, track and intercept even under ideal conditions.[28]

2. Using a Commercial Vessel as a Weapon Delivery System

In the second potential method of maritime attack, enemies could strike the U.S. using commercial vessels as a primitive means of weapons delivery. Attackers could easily conceal a high-yield conventional weapon or WMD onboard a ship. Simply piloting the ship into a high-volume commercial port and detonating this weapon would produce significant physical and economic damage.[29] Several states are suspected of WMD proliferation, including three known state sponsors of terrorism: Iran, Libya and Sudan.[30] In April 2004, General Leon LaPorte, commander of U.S. forces in the Republic of Korea, said "a nuclear weapon in the hands of a terrorist organization is one of our greatest concerns. And given the history of North Korea relative to selling missiles and missile technology, it's a concern we must address."[31] Sandy Berger, National Security Advisor for President Clinton, offered a similar assessment: "[t]he one country

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[26] Christopher Bolkcom and Sharon Squassoni, *Cruise Missile Proliferation*, CRS Report for Congress, RS21252 (Washington, D.C: Library of Congress, 3 July 2002), p 2.

[27] David Isenberg, "The Real Missile Threat: Cruise, non Ballistic," online article (Washington, D.C: Center for Defense Information, 8 July 2002), available from http://www.cdi.org/terrorism/cruise-pr.cfm (accessed 17 March 2006).

[28] United States General Accounting Office, "Cruise Missile Defense: Progress Made but Significant Challenges Remain," report to the Chairman, Subcommittee on Military Research and Development, Committee on Armed Services, House of Representatives, March 1999, 3, available from http://www.gao.gov/archive/1999/ ns99068.pdf (accessed 17 March 2006).

[29] *The National Strategy for Maritime Security*, 3-5.

[30] Counterterrorism Office, U.S. State Department, "State Sponsors of Terrorism," available from http://www.state.gov/s/ct/c14151.htm (accessed 2 December 2005).

[31] General Leon J. Laporte, quoted in Bill Gertz, "North Korea, Al Qaeda Union a Threat," *Washington Times*, online edition, 1 April 2004, available from http://www.washtimes.com/ national/20040331-105348-4826r.htm (accessed 1 December 2005).

that we know has the capacity, and conceivably the inclination, actually to sell a working nuclear weapon to a terrorist group is North Korea. . . . Pyongyang is now capable of producing, and potentially selling, up to six nuclear weapons at any time -- possibly 20 a year by the end of this decade . . . ."[32]

Terrorists could also attempt to acquire WMD without the assistance of a state sponsor. As early as 1993, al Qaeda associates were attempting to acquire weapons-grade uranium on the black market.[33] In a May 1998 Al Qaeda statement titled "The Nuclear Bomb of Islam," Osama bin Laden stated "it is the duty of the Muslims to prepare as much force as possible to terrorize the enemies of God."[34] Al Qaeda spokesman Suleiman Abu Gheith's 2002 statement on his organization's thinking with respect to WMD is chilling:

> We have the right to kill 4 million Americans - 2 million of them children - and to exile twice as many and wound and cripple hundreds of thousands. Furthermore, it is our right to fight them with chemical and biological weapons, so as to afflict them with the fatal maladies that have afflicted the Muslims because of the [Americans'] chemical and biological weapons.[35]

Documentary evidence shows Al Qaeda is not all rhetoric, either. In Pakistan, CNN found an abandoned house that contained "a 25 page document with information about nuclear weapons design."[36] The organization has also been actively pursuing chemical and biological weapons. Coalition forces found a 10-volume "Encyclopedia of

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[32] Samuel R. Berger, "Foreign Policy for a Democratic President," *Foreign Affairs* 83, iss. 3 (May June 2004), 47.

[33] Colum Lynch, "Bin Laden Sought Uranium, Jury Told; Material Said to be from South Africa Offered for $1.5 Million, Ex-Associate Testifies," *The Washington Post*, 8 February 2001. See also, Stephan Leader, "Osama Bin Laden and the Terrorist Search for WMD," *Jane's Intelligence Review* 11, no. 6 (June 1999), available from http://www8.janes.com (accessed 30 November 2005).

[34] Grand Jury Indictment of Mohamed Rashed Daoud Al-'Owhali, et al, in Yonah Alexander and Michael S. Swetnam. *Usama Bin Laden's Al-Qaida: Profile of a Terrorist Network* (Ardsley, New York: Transnational Publishers, 2001), appendix 3, 5.

[35] Suleiman Abu Gheith, quoted in "Why We Fight America: Al-Qa'ida Spokeman Explains September 11 and Declares Intentions to Kill 4 Million American with Weapons of Mass Destruction," *Middle East Media Research Institute (MEMRI) Special Dispatch*, no. 388 (12 June 2002), available from http://memri.org/bin/opener.cgi ?Page=archives&ID=SP38802 (accessed 30 November 2005).

[36] Jack Bourston, "Assessing Al Qaeda's WMD Capabilities," *Strategic Insights* 1, no. 7 (September 2002), available from http://www.ccc.nps.navy.mil/rsepResources/si/sept02/wmd.asp#references (accessed 17 March 2006).

Afghanistan Resistance" near Jalalabad that contained "precise formulas for manufacturing toxins, botullinum, and ricin."[37]

States that acquire WMD also possess the ability to deliver it via non-traditional maritime means, such as a merchant vessel. For terrorist organizations, the problem is somewhat more complicated. Although some report that al Qaeda may have as many as 23 freighters at its disposal, the U.S. government closely monitors those vessels.[38] If prevented from using one of its own vessels to deliver weapons, terrorists could hijack one. Although piloting an ocean freighter is not an easily acquired skill, there are reports of pirates boarding vessels and practicing steering "at various speeds for several hours."[39] Legal means of acquiring ship-driving skills are also available. In November 2002, the United Arab Emirates (UAE) arrested a suspected al Qaeda operative after he attempted to acquire an international seaman's license.[40]

3. Using a Commercial Vessel as a Weapon

Even without acquiring WMD or high-yield conventional explosives, terrorists able to take control of an ocean freighter could use a third attack method. Any large commercial vessel represents a potential weapon in and of itself. Scuttling a vessel in a key sea lane or port could cause extensive economic harm without the use of any other explosive device.[41] If laden with hazardous or explosive materials, the effect could be much more dramatic. By way of comparison, the destruction of the Murrah Federal Building in Oklahoma City was affected by three tons of ammonium nitrate. The *Grandcamp* contained 2,300 tons when it exploded in the Texas City Harbor,[42] and the *Grandcamp* was a small merchant ship by today's standards.

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[37] Bourston, "Assessing Al Qaeda's WMD Capabilities."

[38] James Russell and Illiana Bravo, "Homeland Defense: Ramping Up, But What's the Glidepath," *Strategic Insights* 1, no. 1 (March 2002), available from http://www.ccc.nps.navy.mil/si/mar02/ homeDefense.asp (accessed 17 March 2006). See also, Colin Robinson, "Al Qaeda's 'Navy' – How Much of a Threat," online article (Washington, D.C: Center for Defense Information, 20 August 2003), available from http://www.cdi.org/ friendlyversion/printversion.cfm?documentID=1644 (accessed 15 March 2006), and Peter Grier and Faye Bowers, "How Al Qaeda might strike the US by sea," *The Christian Science Monitor*, 15 May 2003, 2.

[39] Fritelli, 7.

[40] Patrick E. Tyler, "Qaeda Suspect was Taking Flight Training Last Month," *New York Times*, late East coast ed., 23 December 2002, A17.

[41] *The National Strategy for Maritime Security*, 3-5.

[42] *New York Times*, "50 Years Later," A12.

Even more disconcerting, former White House counterterrorism director Richard Clarke charged that after the Millennium terrorist threat, the government learned that al Qaeda-affiliated terrorists had "infiltrated Boston by coming in on liquid natural gas [LNG] tankers from Algeria … [and] had one of the giant tankers blown up in the harbor, it would have wiped out downtown Boston."[43] A Sandia National Laboratories report confirms this assessment.[44] Attackers could use any large ship "as a collision weapon for destroying a bridge or refinery located on the waterfront."[45] Indeed, in April 2006, a 600-foot cargo ship overshot its dock in the Boston Harbor, missing the city's LNG terminal by a margin of only 200 feet.[46] While this incident was unintentional, it highlights the ready availability and vulnerability of critical infrastructure to terrorist attack via hijacked vessels.

4. Maritime Infiltration of Weapons or Personnel

Finally, if attackers cannot gain control of large commercial vessels, they could use smaller ships or private vessels to smuggle personnel or weapons into the United States.[47] With 95,000 miles of coastline, numerous unmonitored beachheads would allow infiltrators to bypass customs and immigration authorities. According to a New York State Office of Homeland Security study on maritime terrorism, al Qaeda might have used one of its freighters, the *Seastar*, to deliver explosives to Saudi Arabia in 1995 for a car bomb attack. Another freighter may have delivered explosives for the bombings of the U.S. embassies in Kenya and Tanzania in August 1998.[48] Additionally, if the al

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[43] Richard A. Clarke, *Against All Enemies: Inside America's War on Terror* (New York: Free Press, 2004), 15.

[44] Mike Hightower, *et al*, *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural as (LNG) Spill Over Water* (Albuquerque, New Mexico: Sandia National Laboratories, December 2004), available from http://www.fossil.energy.gov/programs/oilgas/storage/lng/sandia_lng_1204.pdf (accessed 21 July 2006). See also, Eban Kaplan, "Liquefied Natural Gas: A Potential Terrorist Target?" Council on Foreign Relations, online article, 27 February 2006), available from http://www.cfr.org/ ublication/9810/liquefied_natural_gas.html (accessed 21 July 2006).

[45] Frittelli, 5. See also, *The National Strategy for Maritime Security*, 4.

[46] *The Boston Globe*, "One sunny April day near the LNG tank, a close call on Mystic: A 600-foot ship overshoots dock, and charges fly," online article, 7 May 2006, available from http://www.boston.com/news/local/articles/2006/05/07/one_sunny_april_day_near_the_lng_tank_a_close_ call_on_mystic/ (accessed 21 July 2006).

[47] *Strategy for Homeland Defense and Civil Support*, 16, and *The National Strategy for Maritime Security*, 6.

[48] Christian Weber, *New York State Office of Homeland Security Focus Report: Maritime Terrorist Threat* (New York: New York State Office of Homeland Security, 21 February 2006), 5.

Qaeda associate detained by UAE in November 2002 had successfully obtained his international seaman's license, he would have been able to enter any port in the world without having to acquire a visa.[49]

Stowaways on large vessels present another means for infiltrating personnel into the United States. In April 2006, twenty-two Chinese nationals were arrested in the Port of Seattle for attempting to smuggle themselves into the United States in a 40-foot cargo container. The eighteen men and four women had spent fifteen days in the container on board the China Shipping vessel CSCL *Rotterdam* while it sailed from Shanghai. Fortunately, port security officials spotted the stowaways and summoned U.S. Customs and Border Patrol (CBP) personnel.[50] Although the CBP does not suspect this group had any hostile intentions, the situation highlights the ease by which less-benign groups could bypass normal immigration channels.

In addition to the four primary maritime attack methods discussed above, terrorists could choose to directly engage military or commercial vessels using suicide bombers or other means. Indeed, the attacks on the USS *Cole* (DDG-67) in October 2000 and the French oil tanker M/V *Limberg* two years later are examples of this type of engagement.[51] Nonetheless, such attacks are best thwarted through maritime *security* measures. Developing countermeasures for these types of maritime attacks is beyond the scope of the maritime *defense* mission, defined as "the protection of US sovereignty, territory, domestic population, and critical defense infrastructure against external threats and aggression, or other threats as directed by the President."[52] Accordingly, this thesis will not address defending against these types of attacks.

C. CONCLUSION

A brief examination of the contemporary maritime defense environment reveals a vast area of responsibility ripe for exploitation by asymmetric means. The consequences of a successful maritime attack on the U.S. could be catastrophic. According, all elements of military power merit consideration for this crucial mission area. Careful

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[49] Tyler, A17.

[50] *Traffic World*, "Chinese Stowaways Caught in Seattle," 24 April 2006, 1.

[51] Frittelli, 6.

[52] *Strategy for Homeland Defense and Civil Support*, 5.

consideration might reveal that surface or sub-surface forces are best suited for the maritime defense mission. Equally plausible, however, is that airpower—with its inherent speed, range, and flexibility—can make an important contribution to this mission.

Determining whether or not (and how) air power could and should be used for maritime defense requires several sequential steps. First, reviewing historical and current thinking on the use of air power in the maritime domain lays a foundation for understanding both the capabilities as well as the limitations of air power in a maritime defense role. Second, a discussion of the capabilities-based planning process and its assumptions provides a disciplined methodology for analysis. Third, assessing maritime defense needs and comparing these to current military capabilities reveals where gaps exist between the two. A discussion of possible ways to bridge these gaps reveals whether or not air power can contribute to maritime defense. Finally, a brief examination of different capabilities options—including their impact on operations tempo, training requirements, and the budget—leads to recommendations as to when and how air power could be used for maritime homeland defense.

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II. HISTORICAL AND CURRENT CONCEPTS FOR THE USE OF AIR POWER IN THE MARITIME DOMAIN

A. INTRODUCTION

Twenty-six years prior to the explosions of the *Grandcamp* and *High Flyer* in the Texas City harbor, another vessel, the *Ostfriesland*, sank sixty miles off the coast of Virginia after suffering multiple explosions.[53] The explosions that rocked the *Ostfriesland*, however, were not caused by the detonation of materials on board. Rather, sinking of the captured German battleship on 21 July 1921 marked the climax of a series of joint U.S. Army-Navy maritime bombing tests. The *Ostfriesland* succumbed to an aerial onslaught from eight Army Martin bomber aircraft based at Langley Field, each armed with one specially-constructed two-thousand pound bomb. The first Martin bomber released its weapon from an altitude of 2,500 feet at 12:18 p.m. Over the next ten minutes another five two-thousand pound bombs scored near misses or direct hits on the former man-of-war. Twenty-one minutes after the attack began, "[t]he *Ostfriesland* stood on her port beam ends. Thirty seconds later she started under the waves with a rush, and as her bow turned, large holes were exposed. At 12:40 . . . the dreadnought vanished beneath the surface."[54] Shortly after the sinking, Brigadier General William "Billy" Mitchell, deputy chief of the Army Air Service, declared "the problem of destruction of seacraft by [air] forces has been solved and is finished. . . ."[55]

Mitchell's declaration was premature. Attacking ships at sea was and is a complex problem requiring two distinct capabilities. First, an aircraft and its crew must find the ship. Second, they must successfully engage it. Although the sinking of the *Ostfriesland* tested the later of these capabilities, it largely neglected the former.[56] Over time, however, the problems of locating and destroying ships at sea have become

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53 Alfred P. Hurley, *Billy Mitchell: Crusader for Air Power* (New York: Franklin Watts, 1964), 66.

54 Isaac Don Levine, *Mitchell: Pioneer of Airpower* (New York: Duel, Sloan and Pearce, 1943), 251-257.

55 Billy Mitchell, report to the Chief of the Air Service, September 1921, quoted in Harry H. Ransom, "The Battleship Meets the Airplane," *Military Affairs* 23, no. 1 (Spring 1959), 23.

56 Some argue that Billy Mitchell declined the Navy offer to allow his Army bombers to attack the USS *Iowa* with "dummy bombs" because he worried his airmen would not be able to locate the ship. See Alfred F. Hurley, *Billy Mitchell: Crusader for Air Power* (New York: Franklin Watts, 1964), 67.

progressively easier. Examining this history as well as current doctrine and thinking on the use of aircraft for maritime defense is the first step in determining an appropriate role for air power in this vital mission.

B. THE HISTORY OF AIR POWER IN THE MARITIME DOMAIN

Following Billy Mitchell's success in 1921, navies and air forces around the world quickly attempted to adapt their tactics and weaponry to the anti-ship mission, meeting with only limited success.[57] The difficulties inherent in targeting surface vessels from the air were clearly apparent during World War II.[58] In May 1941, for example, British air and naval forces spent four days in attempting to find and destroy the German battleship *Bismarck*. The chase began on 21 May, when two British Spitfires flying over Bergen, Norway, at 25,000 feet photographed what they thought were two cruisers in the port. Post-flight analysis, however, established that one of the vessels was actually the *Bismarck*.[59] The Royal Air Force (RAF) Coastal Command immediately launched an attack on the area, but bad weather precluded the crew from accomplishing their mission.[60] On 22 May, the RAF returned to reconnoiter the area. Unfortunately for the British, the concise report from the mission simply stated: "Battleship and cruiser have left."[61]

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[57] The most comprehensive work on the relationship between aircraft and surface vessels is Arthur Hezlett, *Aircraft and Sea Power* (New York: Stein and Day, 1970). See also Douglass A. Robinson, *Giants in the Sky: A History of the Rigid Airship* (Seattle: University of Washington Press, 1973), 125-138; R. D. Layman, *Before the Aircraft Carrier: The Development of Aviation Vessels, 1849-1922* (London: Conway Maritime Press, Ltd., 1989); and Hilary St. George Saunders, *The Rise of British Air Power, 1911-1939* (London: Oxford University Press, 1945). An exceptional summary of the use of air power in maritime defense is U.S. Air Force historian Richard P. Hallion, "Air Warfare and Maritime Defense," paper number 45 (Fairbairn, Australia: Air Power Studies Center, Royal Australian Air Force, June 1996). A concise discussion of air power's historical use in the maritime role is Major Roy Walker and Captain Larry Ridolfi, "Airpower's Role in Maritime Operations," *Air and Space Power Chronicles* [online journal], http://www.airpower.maxwell.af.mil/ airchronicles/cc/ridolfi.html (accessed 23 February 2006).

[58] For a discussion of the struggle for supremacy on the seas between air power and the battleship during World War II, see David Hamer, *Bombers Versus Battleships: The struggle between Ships and Aircraft for the Control of the Surface of the Sea* (Annapolis, Maryland: Naval Institute Press, 1998).

[59] Graham Rhys-Jones, *The Loss of the Bismarck: An Avoidable Disaster* (Annapolis, Maryland: Naval Institute Press, 1999), 98.

[60] Robert J. Winklareth, *The Bismarck Chase: New Light on a Famous Engagement* (Annapolis, Maryland: Naval Institute Press, 1998), 65.

[61] Quoted in Rhys-Jones, 103.

Throughout the remainder of the chase, aircraft often sighted the battleship, but radar-equipped Royal Navy vessels performed most of the tracking.[62] Additionally, although an air-delivered torpedo crippled the *Bismarck* and enabled her final destruction from surface fire, poor visibility, heavy anti-aircraft fire, and the battleship's heavy armor precluded any serious damage during most air strikes.[63] During one engagement, aircraft mistakenly attacked the Royal Navy cruiser shadowing the *Bismarck*. Fortunately for the Royal Navy—but indicative of air power's limitations—fusing problems caused several of the torpedoes to detonate prematurely, and the cruiser escaped without damage.[64]

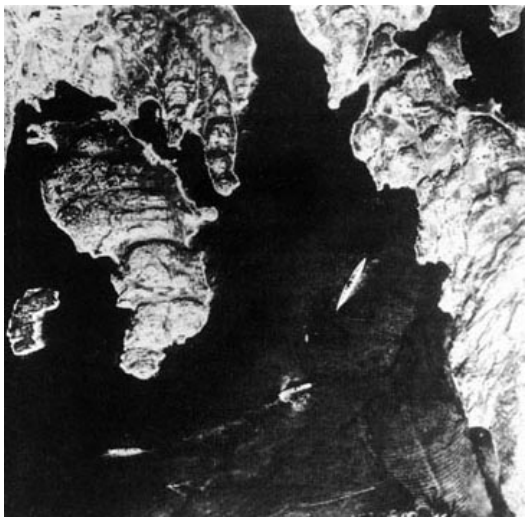

Figure 1. RAF Reconnaissance Photo of Bismarck (Imperial War Museum)[65]

The *Bismarck* episode demonstrated the problems facing aircraft both trying to find and trying to sink a large surface vessel. Yet, even against immobile ships trapped at a known location, World War II aircraft met with uneven success. A telling example of air power's limitations even under these favorable circumstances is the British bombardment of the French fleet in July 1940 at Mers-el-Kebir, Algeria. Not wanting the French vessels to fall into Nazi hands, the British issued an ultimatum to the French fleet to surrender of face destruction. When the French failed to comply, the Royal Navy began the assault. At least nine dive-bombers were launched as part of this attack, but

62 Rhys-Jones, 115.

63 Winklareth, 122-124.

64 Ibid., 135-149.

65 Winklareth, 65.

none succeeded. Not one of their bombs found its target, and two aircraft were lost to anti-aircraft fire. A subsequent air assault on the evading French capital ship *Strasburg* also failed.[66]

Despite these failures, air power did enjoy some successes during World War II. For example, counter to air power's poor performance at Mers-el-Kebir was the Royal Navy's November 1940 air attack on the Italian fleet at Taranto harbor. The Taranto attack resulted in the sinking or disabling of seven surface vessels, crippling the Italian fleet. The Japanese used the Taranto blueprint to plan their even more spectacular and successful attack against the U.S. Pacific Fleet at Pearl Harbor.[67]

The subsequent battle of Midway is also instructive. In June 1942, as a result of breaking Japanese wartime code, the Americans knew an attack on the Midway was imminent.[68] Knowing the attack was coming from the west, U.S. aircraft still faced the monumental task of locating the fleet somewhere in nearly two million square miles of sea. After four days of searching, American aircraft spotted two minesweepers approximately 470 miles southwest of Midway and the Japanese transport group 700 miles to the west of the island. An unsuccessful B-17 strike on the transport group followed later in the day.[69] The next day, aircraft located the main Japanese fleet 200 miles northwest of Midway allowing the battle to "begin in earnest" and ultimately resulting in the destruction of four Japanese aircraft carriers along with several additional ships. Despite the uneven performance of air power prior to the battle, Midway ultimately demonstrated that air power could successfully solve the sequential problems of finding and engaging the enemy.[70]

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[66] David Brown, *The Road to Oran: Anglo-French Naval Relations September 1939-July 1940* (London: Frank Cass, 2004), 198-202.

[67] Thomas P. Loury and John Wellam, *The Attack on Taranto: Blueprint for Pearl Harbor* (Mechanicsburg, Pennsylvania: Stackpole Books, 1995), 101-110.

[68] Hallion, "Air Warfare and Maritime Defense," 30-31.

[69] Robert J. Cressman, *et al*, *A Glorious Page in Our History: The Battle of Midway, 4-6 June 1942* (Missoula, Montana: Pictorial Histories Publishing Company, 1990), 46 and 52-55.

[70] United States Navy, Naval Historical Center, "Preparations for Battle, March 1942 to 4 June 1942 – Overview," available from http://www.history.navy.mil/photos/events/wwii-pac/midway/mid-1m.htm (accessed 10 March 2006), and United States Navy, Naval Historical Center, "Battle of Midway: 4-7 June 1942," available from http://www.history.navy.mil/faqs/faq81-1.htm (accessed 10 March 2006).

Midway was not the only successful case of air power finding and destroying ships at sea. The Japanese followed up their attack on Pearl Harbor by finding and destroying the HMS *Prince of Wales*, *Repulse*, and *Hermes* using land-based torpedo bombers.[71] In the Atlantic theater, the German Luftwaffe met with considerable success against Allied merchant ships, sinking 179 vessels totaling 545,000 tons in the period from March through May 1941.[72] Allied efforts against the Nazis were even more devastating. Of the 920 sinkings of German coastal traffic during World War II, direct air attack and mining claimed 77.3 percent of the total.[73] In the Mediterranean, "Italy lost 1,324 ships (totaling 2,106,521 tons) to allied action." Of these, air attack destroyed 489, or 37 percent of the total.[74]

Since World War II, the ability of aircraft to locate ships has improved steadily. During the 1962 Cuban Missile Crisis, Strategic Air Command (SAC) tasked KC-97, KC-135, RB-47 and B-52 aircraft to find and identify Soviet ships in the mid-Atlantic.[75] President John F. Kennedy's assistant naval aid, Commander Gerry McCabe, wrote in his diary during the crisis that since naval aircraft were busy hunting Soviet submarines,

> General LeMay offered to have his B-52 bombers 'locate all the ships in the Atlantic within four hours,' and he kept his promise. 'Not only did he fly every single plane the Air Force had out over the Atlantic . . . but they sent in every single contact report, from a fishing smack, to the biggest vessel they could find floating on the Atlantic and they swamped the White House Situation Room.'[76]

Throughout the crisis, RB-47 aircraft made a total of 374 sightings of Soviet vessels, including an urgent response to a U.S. Navy request to locate the Soviet tanker *Grozny*. After finding the vessel, the RB-47 crew circled the ship until a Navy destroyer could

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[71] Hallion, "Air Warfare and Maritime Defense," 25-26.

[72] Ibid., 14.

[73] Air Marshall Richard Tedder, *Air Power in War* (London: Hodder and Stoughton, 1948), 58.

[74] Marc Antonio Bragadin, *The Italian Navy in World War II*, trans. Gale Hoffman (Annapolis, Maryland: U.S. Naval Institute, 1957), 366.

[75] Hallion, "Air Warfare and Maritime Defense," 54.

[76] Robert W. Love, Jr., *History of the US Navy, Volume II* (Harrisburg, Pennsylvania: Stackpole Books, 1992), 458.

intercept it. Throughout the crisis SAC flew over 5,000 sea-surveillance sorties, "demonstrating the enduring value of strategic bombers employed in maritime roles."[77]

Air power also has improved in its ability to engage and destroy surface vessels. The 1982 Falklands War illustrated the vulnerability of modern ships to air attack. After being hit by an Argentinean Exocet missile, the HMS *Sheffield* sank despite the missile's failure to detonate. All told, the British lost six ships during the conflict,[78] but they could have fared even worse. "Fully 55% of Argentine bombs failed to explode even though they hit their targets. Had they [exploded], it is likely that at least six of the other thirteen vessels damaged would have been lost."[79] Five years later, the Iraqi engagement of the USS *Stark* (FFG-31) demonstrated the continued efficacy of air power against surface ships. On 17 May 1987, an Iraqi Mirage F-1 fighter fired two French-made Exocet anti-ship missiles at the vessel. Although the first missile failed to detonate, the second exploded three feet inside ship's skin. The resultant fire reached temperatures of 1400-1500º F in less than one minute. The engagement resulted in the loss of thirty-seven lives and $142 million in damage.[80]

Figure 2. USS Stark after being Struck by Iraqi Missiles (USN Photo)

In part as a result of the attack on the *Stark*, the US Navy has an institutionalized respect for airborne threats. Indeed, just over one year after the crippling of the *Stark*, the

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[77] Hallion, "Air Warfare and Maritime Defense," 54.

[78] Martin Middlebrook, *Operation Corporate: The Falklands War1982* (New York: Viking, 1985).

[79] Richard A. Hallion, "Air Power and Asymmetric Threats," remarks to the Royal Australian Air Force 2000 Air Power Conference, 7, available from http://www.raaf.gov.au/ airpower/publications/conferences/2000/ hallion.pdf (accessed 7 March 2006).

[80] U.S. Naval Sea Systems Command, DC Museum, "USS Stark," online article, available from http://www.dcfp.navy.mil/mc/museum/STARK/Stark3.htm (accessed 21 July 2006).

commanding officer of the USS *Vincennes* (CG-49) cited that incident as part of his rationale for engaging what he perceived as a hostile Iranian air threat.[81] Unfortunately, that threat later proved to be a civilian airliner, Iran flight 655. Conversely, the Navy has also demonstrated its own ability to effectively employ naval air power against enemy ships. The most recent example of this is during the 1991 Gulf War, when naval aircraft damaged or destroyed nineteen Iraqi naval vessels on a single day.[82]

C. AIR POWER IN CURRENT MARITIME DEFENSE DOCTRINE

The steadily improving capabilities of air power to find and destroy surface vessels have led to only limited examinations of its role in maritime defense, particularly against an asymmetric-type threat. Most available studies of maritime strategy primarily focus on Cold War and post-Cold War conventional maritime defense (or offense).[83] The 1992 naval strategy document *From the Sea* reoriented the Navy from a blue water strategy to one focused on power projection and operations in the littorals.[84] U.S. Navy Commander Michael Dobbs expanded on the forward presence strategy of *From the Sea*, adopting it to the homeland defense mission. Dobbs demonstrated the applicability of the Navy's counter-drug efforts to the maritime interdiction mission, and highlighted the importance of achieving maritime domain awareness (MDA).[85] Unfortunately, however, he does not discuss the potential use of air assets in the maritime mission.

Neglecting to address the use of air power for maritime defense is a common oversight. The few efforts that do discuss air power's potential in the maritime role do not offer any strategic or operational guidance. Instead, they focus on the use of specific

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[81] U.S. Department of Defense, *Investigation Report: Formal Investigation into the Circumstances Surrounding the Downing of Iran Air Flight 655 on 3 July 1988* (Washington, D.C: Department of Defense, 1988), 44.

[82] Walker and Ridolfi.

[83] See, for example, Norman Friedman, *The US Maritime Strategy* (New York: Jane's, 1988); John B. Hattendorf, *Naval History and Maritime Strategy: Collected Essays* (Malabar, Florida: Krieger Publishing, 2000); Peter M. Swartz, Jan S. Breemer, and James John Tritten, *The Maritime Strategy Debates: A Guide to the Renaissance of U.S. Naval Strategic in the 1980s*, revised ed. (Monterey, California: Naval Postgraduate School, 1989); Geoffrey Till, *Maritime Strategy and the Nuclear Age*, 2nd ed. (New York: St. Martin's Press, 1984); and United States Naval Institute, *The Maritime Strategy* (Annapolis, Maryland: U.S. Naval Institute, 1986).

[84] United States Navy, *From the Sea*: *Preparing the Naval Service for the 21st Century* (Washington, D.C: U.S. Navy, September 1992, available from http://www.chinfo.navy.mil/navpalib/policy/fromsea/fromsea.txt (accessed 17 March 2006).

[85] Michael Dobbs, "Homeland Security …From the Sea," *RUSI Journal* 147, no. 4 (August 2002), 60-61.

platforms, neglecting broad strategic principles or concepts of operation.[86] One Royal Air Force author does provide an in-depth discussion of maritime air defense, concluding that the advantages of "range, information-processing and weapon-carrying capabilities, and flexibility" make land-based aircraft particularly well-suited for this mission.[87] Unfortunately, this work also fails to adequately address strategic or operational employment.

U.S. government strategy documents offer another possible source of guidance for maritime defense planning. Although the U.S. *National Security Strategy* does not discuss maritime defense directly, it states the strategic objective of "identifying and destroying the threat before it reaches our borders."[88] The U.S. *National Defense Strategy* subsequently identifies the number one strategic objective of the Armed Forces as "secur[ing] the United States from direct attack,"[89] and it lists air and maritime defense as critical components of protecting the homeland.[90] The *National Military Strategy* provides slightly more detail, stating that the U.S. will "form an integrated defense of the air, land, sea and space approaches in and around US sovereign territory." The authors continue, stating that "[p]rotecting these strategic approaches requires persistent surveillance that allows the United States to identify, continuously track and interdict potential threats," thereby highlighting the critical importance of intelligence, surveillance and reconnaissance in maritime defense.[91]

The Department of Defense's *Strategy for Homeland Defense and Civil Support* details the military's vision for accomplishing the maritime defense mission. Following the lead of the *National Military Strategy*, the *Strategy for Homeland Defense and Civil*

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[86] Donald D. Chipman and Major David Lay, "Sea Power and the B-52 Stratofortress," *Air University Review* (January-February 1986). Several U.S. Air Force Weapons School papers also exist for various weapons systems. An index of unclassified papers is available from https://wwwmil.nellis.af.mil/usafws/default.htm (accessed 17 March 2006).

[87] Group Captain B. C. Laite, *Maritime Air Operations* (London: Brassey's, 1991), 138.

[88] President of the United States, *The National Security Strategy of the United States of America* (Washington, D.C: The White House, September 2002), 6.

[89] U.S. Department of Defense, *The National Defense Strategy of the United States of America* (Washington, D.C: Department of Defense, March 2005), 6.

[90] Ibid., 9.

[91] U.S. Joint Chiefs of Staff, *National Military Strategy of the United States of America: A Strategy for Today, a Vision for Tomorrow* (Washington, D.C: Department of Defense, 2004), 10.

Support outlines the concept of an "active, layered defense." This defense "relies on early warning of an emerging threat in order to quickly deploy and execute a decisive response."[92] Consequently, the authors of the *Strategy for Homeland Defense and Civil Support* list as their first objective "achieving maximum awareness of threats." They further define the desired level of threat awareness as "comprehensive, accurate, timely and actionable intelligence and information" that allows warfighters and policymakers to identify and respond to threats.[93] Meeting this threshold allows accomplishment of a second objective, to "deter, intercept, and defeat threats at a safe distance." The authors acknowledge that to do this the military needs a system that provides situational awareness similar to that used for air traffic control and air defense. However, the only discussion of how to actually engage and defeat a maritime threat is a quote from the Chief of Naval Operations (CNO). The authors apparently concur with the CNO's statement that "forward deployed naval forces will network with other assets of the Navy and Coast Guard . . . to identify, track and intercept threats long before they threaten the nation."[94] Later in the document, when discussing the capability to intercept and defeat threats in the maritime operational domain, the discussion revolves exclusively around using U.S. Navy and Coast Guard forces to conduct maritime defense missions.[95]

Building on the *Strategy for Homeland Defense and Civil Support*, the DoD's *Joint Operations Concepts* (JOpsC) document describes the specific operational concepts for how the DoD will execute maritime homeland defense. It describes an operationalized mission set for maritime defense comprised of "attack operations, active defense, passive defense and C4I [command, control, communications, computers, and intelligence]."[96] The *Department of Defense Homeland Security Joint Operating Concept* (HLS JOC) also reflects these mission sets in its approach to maritime defense. The HLS JOC divides the world into three main areas: the forward regions, approaches, and homeland. In the forward regions, DoD's objective is to "detect, deter, prevent, and

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[92] *Strategy for Homeland Defense and Civil Support*, 10.

[93] Ibid., 15-16.

[94] *Strategy for Homeland Defense and Civil Support*, 16.

[95] Ibid., 25.

[96] U.S. Department of Defense, *Joint Operations Concepts* (Washington, D.C: Department of Defense, November 2003), 18.

defeat threats and aggression aimed at the US before they can directly threaten the Homeland."[97] The HLS JOC envisions carrying out this mission "independently, through preemptive attack (if actionable intelligence is available), or in conjunction with major combat operations, stability operations, and/or strategic deterrence."[98] Regrettably, the HLS JOC does not delve deeper into the capabilities required to successfully carry out such a preemptive attack.

When discussing homeland defense operations in the approaches, the HLS JOC fares only slightly better. The document begins by describing the approaches as

> a conceptual region extending from the limits of the Homeland to the boundaries of the Forward Regions that is based on intelligence – once intelligence has indicated a threat is en route to the Homeland, it is considered to be in the Approaches.[99]

The HLS JOC describes DoD's objectives in the approaches using the same language as it did for the forward regions: "to detect, deter, prevent, and defeat transiting threats as far from the Homeland as possible." [100] In this section, however, the HLS JOC provides a rudimentary discussion of capabilities requirements, stating that DoD can achieve its objectives in the approaches "through surveillance and reconnaissance . . . and maritime interception."[101] Once a threat penetrates the approaches, the HLS JOC again states that DoD requires capabilities to "[d]etect, deter, prevent, and defeat maritime threats to the Homeland."[102] Expanding on this objective later in the document, the HLS JOC identifies capabilities requirements that include "detection, localization, evaluation, sorting, and possible interception, by force if necessary, of maritime traffic to prevent or defeat an attack."[103] Nonetheless, the HLS JOC stops short of discussing the specific options for filling each of these capabilities requirements for the maritime defense mission.

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[97] U.S. Department of Defense, *Department of Defense Homeland Security Joint Operating Concept* (Washington, D.C: Department of Defense, February 2004), 3. Cited hereafter as *HLS JOC*.

[98] Ibid.

[99] *HLS JOC*, 3-4.

[100] Ibid., 4.

[101] Ibid.

[102] Ibid.

[103] Ibid., 21.

DoD and joint publications do not discuss potential uses of air power for maritime defense. Unfortunately, current Air Force doctrine fares only slightly better. In 2003, the Air Force revised Air Force Doctrine Document 1 (AFDD 1), *Air Force Basic Doctrine*, to include a robust focus on protecting the homeland. Despite this, AFDD 1 includes only one paragraph on countersea operations. In this single paragraph AFFD 1 states that "countersea functions are an extension of Air Force capabilities into a maritime environment" and include the tasks of "sea surveillance, antiship warfare [subsequently renamed surface warfare], protection of sea lines of communications through antisubmarine and antiair warfare, aerial minelaying, and air refueling in support of naval campaigns."[104] These tasks are all collateral missions that Department of Defense Directive (DODD) 5100.1, *Functions of the Department of Defense and Its Major Components*, assigned to the Air Force.[105] Sea surveillance and surface warfare are the most significant of these collateral missions for homeland defense.

Air Force Doctrine Document 2-1.4 (AFDD 2-1.4), *Countersea Operations*, provides definitions for sea surveillance and surface warfare but does not give any further doctrinal guidance pertaining to their execution.[106] Similarly, AFDD 2-1.4 is silent on the operational issues inherent in using air power for maritime defense. AFDD 2-1.4 cautions that when USAF assets are operating in the maritime domain, "[c]oordinating, synchronizing, and integrating land-based air operations with maritime air and sea operations [is] challenging, but necessary."[107] The document's limited discussion of joint forces air component commander (JFACC) and maritime component commander

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[104] United States Air Force, *Air Force Doctrine Document 1: Air Force Basic Doctrine* (Washington, D.C: U.S. Air Force, 17 November 2003), 45, available from http://www.e-publishing.af.mil/pubfiles/af/dd/afdd1/ afdd1.pdf (accessed 10 March 2006). Hereafter cited as *AFDD 1*.

[105] U.S. Department of Defense, *Department of Defense Directive (DODD) 5100.1: Functions of the Department of Defense and Its Major Components* (Washington, D.C: Department of Defense, 1 August 2002), available from http://www.dtic.mil/whs/directives/corres/html2/d51001x.htm (accessed 10 March 2006).

[106] United States Air Force, *Air Force Doctrine Document 2-1.4: Countersea Operations*, 15 September 2005, 3, available from www.e-publishing.af.mil/pubfiles/af/dd/afdd2-1.4/afdd2-1.4.pdf (accessed 10 March 2006). Hereafter cited as *AFDD 2-1.4*.

[107] Ibid., 19.

(JFMCC) coordination concludes that the JFACC should control all air forces, although the JFMCC "in some situations, may plan and direct limited Air Force support operations."[108]

DoD, joint, and Air Force strategy and doctrine documents do not provide any guidance on the appropriate uses of air power in the maritime defense mission. While this could indicate a tacit proscription against using air power for this mission, these documents do not offer any reasoning that might support such a claim. More likely, the absence of a strategic or doctrinal discussion on appropriate uses for air power in maritime defense represents a void in current operational thought. To fill this void will require a disciplined and methodological approach to the problem of maritime defense. Accordingly, a capabilities-based planning methodology will provide the framework for enumerating the assumptions and military requirements for maritime homeland defense.

[108] United States Air Force, *Air Force Doctrine Document 2-1.4: Countersea Operations*, 15 September 2005, 3, available from www.e-publishing.af.mil/pubfiles/af/dd/afdd2-1.4/afdd2-1.4.pdf (accessed 10 March 2006). Hereafter cited as *AFDD 2-1.4.*, 18.

III. CAPABILITIES-BASED PLANNING METHODOLOGY

A. INTRODUCTION

In the wake of the terrorist attacks on 9/11, the 2001 Quadrennial Defense Review (QDR) recognized that planning for large conventional wars was no longer adequate to defend the nation. Instead, the report noted, "the United States must identify the capabilities required to deter and defeat adversaries who will rely on surprise, deception, and asymmetric warfare to achieve their objectives."[109] Accordingly, Secretary of Defense Donald Rumsfeld directed the U.S. military to adopt a capabilities-based approach to planning. This approach was designed to focus the services "more on how an adversary might fight than who the adversary might be and where a war might occur."[110] Outside of this broad definition from the QDR, there is no official DoD definition of capabilities-based planning.[111] Fortunately, however, unofficial guidance on the planning process does exist.

In a study conducted for the office of the secretary of defense (OSD), Paul K. Davis of the RAND Corporation defines capabilities-based planning as "planning, under uncertainty, to provide capabilities suitable for a wide range of modern-day challenges and circumstances, while working within an economic framework."[112] Capabilities-based planning is especially relevant to homeland defense and homeland security. The high degree of uncertainly surrounding asymmetric warfare—whether with another state or a non-state actor—challenges planners. Furthermore, "[a]symmetric threats target unappreciated vulnerabilities, and they tend to result in surprise."[113] This uncertainty leads planners either to "mirror-image" the threat or focus on more traditional, "proven"

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109 U.S. Department of Defense, *Quadrennial Defense Review Report* (Washington, D.C: U.S. Department of Defense, 2001), iv.

110 Ibid., 13.

111 U.S. Department of Defense, *Joint Publication 1-02: Department of Defense Dictionary of Military and Associated Terms* (Washington, D.C: U.S. Department of Defense, 14 April 2006).

112 Paul K. Davis, *Analytic Architecture for Capabilities-Based Planning, Mission-System Analysis, and Transformation* (Santa Monica, California: RAND Corporation, 2002), 1.

113 Bruce W. Bennett, "Responding to Asymmetric Threats," in Stuart Johnson, Martin Libicki, and Gregory F. Treverton, eds., *New Challenges, New Tools for Defense Decisionmaking* (Santa Monica, California: RAND Corporation, 2003), 43.

threats from nation-states.[114] Former Central Intelligence Agency analyst Richards Heuer has warned about the pernicious effects of mirror-imaging. While his comments specifically addressed intelligence analysis of state threats, they are equally applicable to non-state actors.

> To see the options faced by foreign [or terrorist] leaders as these leaders see them, one must understand their values and assumptions and even their misperceptions and misunderstandings. Without such insight, interpreting foreign [or terrorist] leaders' decisions or forecasting future decisions is often little more than partially informed speculation. Too frequently, foreign [or terrorist] behavior appears "irrational" or "not in their own best interest." Such conclusions often indicate analysts have projected American values and conceptual frameworks onto the foreign [or terrorist] leaders and societies, rather than understanding the logic of the situation as it appears to them.[115]

Furthermore, as Army Lieutenant Colonel Thomas Goss concluded in a study on the use of capabilities-based planning for homeland defense, threat-based or scenario-based methods fail "because the asymmetric threat cannot be templated and is both uncertain and adaptive."[116]

Capabilities-based planning has several advantages over threat- or enemy-specific scenario-based planning for homeland defense and security. Because it focuses the planner's attention on threat capabilities and potential responses instead of particular threat nations or groups, capabilities-based planning inherently emphasizes "flexibility, robustness, and adaptiveness of capability."[117] Furthermore, because the capabilities-based construct is an iterative process accounting for both needs and resources constraints, it lends itself to a deeper understanding of required capabilities. This, in turn, affords the planner the opportunity to develop several capability options for the decision-

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[114] Bennett, 44.

[115] Richards Heuer, *The Psychology of Intelligence Analysis* (Washington, D.C: Central Intelligence Agency and Center for the Study of Intelligence, 1999), 33, available from https://www.cia.gov/csi/Psychology/PsychofIntelNew.pdf (accessed 27 July 2006).

[116] Thomas J. Goss, *Building a Contingency Menu: Using Capabilities-based Planning for Homeland Defense and Homeland Security*, Master's thesis (Monterey, California: Naval Postgraduate School, March 2005), 14.

[117] Davis, 4.

maker. The decision-maker can then choose what capability best fits not only defense needs, but also economic constraints and the acceptable level of risk.[118]

B. THE CAPABILITIES-BASED PLANNING PROCESS

The RAND Corporation's capabilities-based planning process is outlined in Figure 3. The first step in this process is to identify plausible threat concerns, and RAND suggests doing this by listing several name-level scenarios. These scenarios should be "defined only to the extent of giving them names that indicate broadly the nature of conflict being considered."[119] The four maritime defense scenarios discussed in the introductory chapter provide the baseline for accomplishing this capabilities-based planning step. Those scenarios were using a commercial vessel as a launch platform, using a commercial vessel as a weapon delivery system, using a commercial vessel as a weapon, and maritime infiltration of weapons or personnel. It is important to note that changes in intelligence quality, specificity, and timeliness will suggest different capability needs in each of these scenarios.[120] Thus, including an intelligence warning parameter as part of maritime defense scenario development adds a level of sophistication and precision to the planning process.

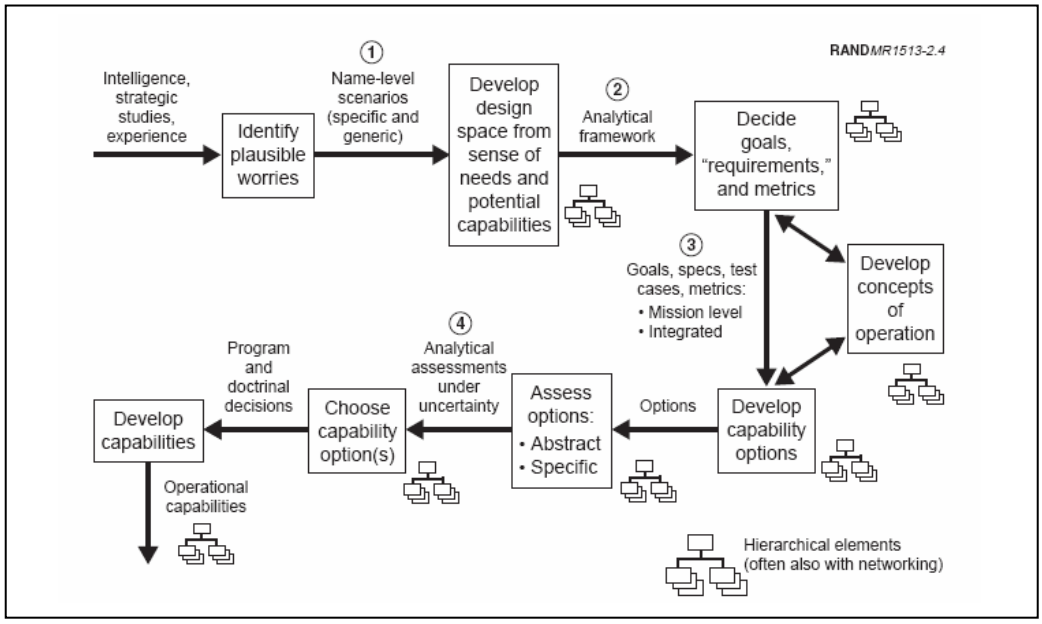

Figure 3. Capabilities-based Planning Process (RAND Corporation)

[118] Davis, 4.

[119] Ibid., 15.

[120] Goss, 52-3.

The second step in the capabilities-based planning process is development of the design space. This design space is simply the area available for problem solving, as defined by assumptions. As such, the design space provides an analytical framework for subsequent steps in the planning process.[121] According to RAND, the design space for capabilities-based planning consists of six primary dimensions: the political-military context, enemy objectives and strategies, enemy forces, enemy force effectiveness, the environment, and other model assumptions (e.g., the movement speed of maneuver forces, real-world weapon effectiveness).[122] Defining the design space enables the discussion of various concepts of operations (CONOPS) during the next phase of the capabilities-based planning process.

A well constructed design space will recognize "the full dimensionality of uncertainty" inherent in the planning process.[123] For maritime defense and security, part of the uncertainly facing military planners is the difficulty distinguishing between the maritime homeland defense and maritime homeland security missions. This distinction—or lack thereof—is a critical part of the political-military context of the maritime mission, and therefore a critical dimension of a capabilities-focused design space. Before discussing the other assumptions having an impact on the design space, a more in-depth look at the similarities and differences between maritime homeland defense and security is appropriate.

C. MARITIME HOMELAND DEFENSE VERSUS SECURITY

The line between homeland defense and homeland security is always tenuous, and it is especially blurred in the maritime realm. Both the Department of Homeland Security (DHS) and DoD have a role in protecting the U.S. from maritime threats. The *National Strategy for Homeland Security* defines homeland security as "a concerted national effort to prevent terrorist attacks within the United States, reduce America's vulnerability to terrorism, and minimize the damage and recover from attacks that do occur."[124] DoD defines homeland defense as "the protection of US sovereignty, territory, domestic

[121] Davis, 21.

[122] Ibid., 23.

[123] Ibid., 21.

[124] Office of Homeland Security, *National Strategy for Homeland Security* (Washington, D.C: The White House, July 2002), 2.

population, and critical defense infrastructure against external threats and aggression, or other threats as directed by the President."[125] Since external threats and aggression include terrorism, the main distinction between homeland security and homeland defense is that the former focuses on prevention and recovery, while the latter emphasizes a military response to known threats. DoD specifically precludes itself from homeland security (with the exception of assisting during recovery), stating it "does not have the assigned responsibility to stop terrorists from coming across our borders, to stop terrorists from coming through US ports, or to stop terrorists from hijacking aircraft inside or outside the United States."[126] Instead, DoD "executes military missions that dissuade, deter, and defeat attacks upon the United States, our population, and our defense critical infrastructure."[127]

While the distinction between homeland defense and homeland security makes sense on paper, it is often difficult to apply in the real-world. This is especially true with respect to the distinctions between maritime security and maritime defense. For example, consider a scenario where terrorists intend to use a ship as a weapon. Presume the U.S. government receives intelligence that terrorists have taken control of a ship inbound to a port on the west coast of the United States. At this point, whose responsibility is it to stop the ship from entering the port? On the one hand, DHS and the U.S. Coast Guard appear to have a clear role, since they are tasked with preventing terrorist attacks on the homeland. On the other hand, DoD could claim a role since it is responsible for defeating attacks in progress.

The *Maritime Operational Threat Response for the National Strategy for Maritime Security* attempts to resolve this ambiguity by giving DoD the responsibility for "maritime terrorist threats that occur in the forward maritime areas of responsibility."[128] Accordingly, the Chief of Naval Operations has stated that the Navy "will identify, track,

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[125] *Strategy for Homeland Defense and Civil Support*, 5.

[126] Ibid.

[127] Ibid., 2.

[128] Maritime Security Policy Coordinating Committee, *Maritime Operational Threat Response for the National Strategy for Maritime Security* (Washington, D.C: National Security Council/Homeland Security Council, October 2005), 6.

and intercept dangers long before they threaten our homeland."[129] While DoD is responsible for the forward areas, the *Maritime Operational Threat Response* (MOTR) plan assigns DHS the responsibility to interdict maritime threats in waters subject to U.S. jurisdiction, drug interdiction areas, offshore waters, and the Caribbean Sea.[130] Nonetheless, the MOTR plan is somewhat equivocal on this point, allowing exceptions to its pre-designated lead agency responsibilities based on existing law, desired outcomes, greatest potential magnitude of the threat, response capabilities required, asset availability, and authority to act.[131]

These exceptions have the potential to create confusion over who has lead agency responsibilities. During a 2005 exercise, Coast Guard and Federal Bureau of Investigation (FBI) ship-boarding teams reportedly clashed over who had the lead after the mock hijacking of a 200-foot ferry off the Connecticut coast.[132] According to a Department of Justice (DOJ) inspector general (IG) report, the FBI wanted to employ its Hostage Rescue Team (HRT), while the Coast Guard wanted to make use of its Enhanced Maritime Safety and Security Team. FBI officials expressed concern that the MOTR plan did "not define the roles of the FBI and the Coast Guard as clearly as they would like."[133] The IG report concluded that "a lack of jurisdictional clarity in the MOTR could hinder the ability of the FBI and the Coast Guard to coordinate an effective response to a terrorist threat or incident in the maritime domain."[134]

Even in the forward areas assigned to DoD for maritime defense, situations often arise where a non-DoD led team is desirable. For example, under Title 14 of the U.S.

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[129] Admiral Vern Clark, "Sea Power 21 Series—Part I: Projecting Decisive Joint Capabilities," United States Naval Institute *Proceedings* (October 2002), available from http://www.usni.org/Proceedings/Articles02/ PROcno10.htm (accessed 18 May 2006).

[130] *Maritime Operational Threat Response*, 7.

[131] Ibid., 6.

[132] Mark Sherman, "Coast Guard, FBI tension threatens response to sea-based terrorism, Justice watchdog says," *The Boston Globe* online article (3 April 2006), available from http://www.boston.com/news/local/connecticut/articles/2006/04/03/report_conflicts_threaten_response_to_sea_based_terrorism/?rss_id=Boston.com+%2F+News+%2F+Local (accessed 18 May 2006).

[133] Audit Division, Office of the Inspector General, U.S. Department of Justice, *The Federal Bureau of Investigation's Efforts to Protect the Nation's Seaports*, Audit Report 06-26 (March 2006), 42, available from http://www.usdoj.gov/oig/reports/FBI/a0626/final.pdf (accessed 18 May 2006).

[134] Ibid.

Code, the Coast Guard is simultaneously a military service and law enforcement organization.[135] Thus, in situations where a suspect vessel requires boarding to search for weapons of mass destruction (WMD) or other threatening cargo, a Coast Guard Law Enforcement Detachment (LEDET) embarked on a Navy vessel normally leads the effort. The Coast Guard first established LEDETs in 1982 as a means of carrying out the Coast Guard's counter drug mission. Since U.S. Navy ships often transited drug enforcement areas, deploying LEDETs on these vessels vastly increased the Coast Guard's law enforcement reach.[136] Members of Coast Guard LEDETs "conduct boardings and carry out law enforcement activities that members of the Navy are not authorized to do."[137] In such cases not only do Coast Guardsmen lead the boarding party, but "the Naval warship hoists the Coast Guard flag onto its signal halyard in a fashion observable by the target vessel (even illuminating the Coast Guard flag at night)."[138]

Illustrative of the value of Coast Guard LEDETs for maritime homeland defense is their role in counter-WMD proliferation efforts under the Proliferation Security Initiative (PSI). The PSI is an activity where participating nations board and search ships suspected of WMD smuggling. By formally committing to the *Statement of Principles*, PSI participants agree to work together to interdict "the transfer or transport of WMD, their delivery systems, and related materials to and from states and non-state actors of proliferation concern." This includes a commitment to "board and search any vessel flying their flag in their internal waters or territorial seas . . . that is reasonably suspected of transporting such cargoes to or from states or non-state actors of proliferation concern" and to consent to search of their own-flagged vessels by other states if required.[139] The most recent Coast Guard LEDET participation in the PSI was in August 2005 during

[135] 14 USC § 2.

[136] The Subcommittee on Coast Guard and Maritime Transportation, Resources Committee, U.S. House of Representatives, "Hearing on Coast Guard Law Enforcement," 15 June 2005, available from http://resourcescommittee.house.gov/transportation/cgmt/06-15-05/06-15-05memo.html (accessed 18 May 2006).

[137] Ibid.

[138] Kimberley L. Thachuk and Sam J. Tangredi, "Transnational Threats and Maritime Responses," in Sam J. Tangredi, ed., *Globalization and Maritime Power* (Washington, D.C: National Defense University Press, 2002), 57.

[139] Bureau of Nonproliferation, U.S. Department of State, *The Proliferation Security Initiative: Statement of Interdiction Principles*, 28 July 2004, available from http://www.state.gov/t/np/rls/other/34726.htm (accessed 30 November 2005).

exercise DEEP SABRE. In this exercise the U.S. Navy destroyer USS *John Paul Jones* (DDG-53) hosted an embarked Coast Guard LEDET ship-boarding team.[140] This example suggests that for legal reasons the Coast Guard might be a more appropriate lead than DoD for ship boardings and searches. As mentioned early, legality is one of the criteria in the MOTR plan for determining the lead federal agency for maritime missions.

As the above discussion highlights, the distinction between maritime defense and maritime security is often blurred. The difficulty inherent in distinguishing between these missions presents several operational problems to maritime defense planners. The level of force acceptable in different scenarios varies widely based on the nature of the threat, quality of intelligence available on the threat, and proximity of the threat to the homeland. These factors will be critical to the development of a maritime homeland defense CONOPS.

D. CONSTRUCTING THE DESIGN SPACE

In addition to the tension between maritime defense and security, the design space is affected by enemy objectives and strategies, force characteristics, force effectiveness, and the environment. Since "al Qaeda remains America's most immediate and serious threat,"[141] the following discussion of each of these design space dimensions will center on that organization. It is important to note, however, that the design space constructed below applies equally to any state or non-state actor engaging the U.S. through asymmetric maritime attack. The identity of the attacker is not important. What is important is that those who cannot compete with the U.S. in head-to-head conventional combat share a will and capability to attack the U.S. using unconventional, asymmetric means.

1. Objectives and Strategies

Like most state and non-state actors, Bin Laden's network has clearly-defined and specific strategic objectives. Peter Bergen, a journalist who has met with al Qaeda's leader, notes "bin Laden cares little about . . . cultural issues."[142] The terrorist leader

[140] Office of the Spokesman, U.S. Department of State, *Singapore Hosts Proliferation Security Initiative (PSI) Interdiction Exercise (DEEP SABRE)*, Media Note, 12 August 2005, available from http://www.state.gov/r/pa/ prs/ps/2005/51032.htm (accessed 18 May 2006).

[141] *National Strategy for Homeland Security*, vii.

[142] Peter L. Bergen, *Holy War, Inc: Inside the Secret World of Osama bin Laden*, (New York: The Free Press, 2001), 222.

does not "rail against the pernicious effects of Hollywood movies, or against Madonna's midriff, or against pornography."[143] Rather than a war of cultures, Bin Laden's is "a *political* war."[144] Al Qaeda's long term goal is to establish a Muslim Caliphate in the Middle East. The shorter term objectives that support this goal include the overthrow secular and corrupt Muslim governments (those that do not apply Islamic law) and the removal of U.S. troops from the region.[145] These al Qaeda objectives help to define the design space by broadly delineating expected al Qaeda courses of action. Since the removal of U.S. forces from the Middle East would further the organization's long and short term goals, planners need to ask how al Qaeda could affect an American withdrawal from the region. Two broad courses of action are available: direct attacks on forces in theater, or asymmetric attacks on the support base of those forces on U.S. territory. The attack on the USS *Cole* is an example of the former; the 9/11 attacks represent the latter strategy.

Al Qaeda also has shorter term organizational goals, and these it shares with other asymmetric-type threats to U.S. national security. Foremost, al Qaeda and other asymmetric threats want to survive.[146] Because these threat types are weak relative to the United States, this survival objective is in tension with their political objectives. For example, mounting a large-scale conventional assault on U.S. forces would be the most effective means of driving the U.S. out of the Gulf region. Fortunately, al Qaeda cannot mount such an attack. Not only would the attack fail in the face of U.S. conventional superiority, but the organization would likely be decimated in the process. Thus, as long as the U.S. faces state or non-state enemies that are relatively weak, the U.S. must expect a strategy of asymmetric attack against key vulnerabilities. As the *National Defense Strategy* stated, the U.S. "enjoy[s] significant advantages vis-à-vis prospective competitors . . . [but has] learned that an unrivaled capacity to respond to *traditional*

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[143] Bergen, 222.

[144] Ibid.

[145] Alexander and Swetnam, 2.

[146] J. Bowyer Bell, "Revolutionary Dynamics: The Inherent Inefficiency of the Underground," *Terrorism and Political Violence* 2 (1990), 193-211. See also, Martha Crenshaw, "The Causes of Terrorism," *Comparative Politics* 13, no. 4. (July 1981), 387.

challenges is no longer sufficient."[147] In the case of the 9/11 attacks on the U.S., al Qaeda has clearly stated the purpose of the attacks was to wage asymmetric warfare. Al Qaeda military commander Sayf Al Adl identified a desire to "carry out a damaging strike against the United States in retaliation for its perceived aggression in the Islamic world,"[148] and bin Laden himself has made statements revealing "sophisticated consideration of the economic and military vulnerabilities of the United States and its allies."[149]

One troubling component of al Qaeda's asymmetric strategy is the potential use of WMD. As Jessica Stern has argued, mass casualty attacks are entirely rational given Al Qaeda's effort to undermine the U.S. government. Ramzi Yousef, an al Qaeda associate convicted for his role in the 1993 bombing of the World Trade Center, hoped his efforts would topple the buildings and kill 250,000 Americans.[150] Acquisition of nuclear, biological or chemical weapons would make such massive killing significantly easier, helping al Qaeda meet its strategic objectives. Al Qaeda clearly understands this. The introductory chapter of this thesis outlined several of al Qaeda's previous attempts to acquire WMD. Additionally, in a 1999 interview with Newsweek International, bin Laden stated "[w]e don't consider it a crime if we tried to have nuclear, chemical, biological weapons."[151] The possibility of a WMD attack—and the catastrophic consequences thereof—are an elemental part of the capabilities-based design space.

2. Force Characteristics

According to the *National Strategy for Combating Terrorism*, the terrorist threat is "is a flexible, transnational network structure, enabled by modern technology and

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147 *National Defense Strategy*, 6.

148 Christopher M. Blanchard, *Al Qaeda: Statements and Evolving Ideology*, CRS Report for Congress, RL32759 (Washington, D.C: Library of Congress, updated 20 June 2005, 4.

149 Ibid., 11. See also, Osama bin Laden, "Eighth Al Qaeda Statement," 30 October 2004, available from http://www.doublestandards.org/alqa.html (accessed 21 May 2006).

150 Jessica Stern, "Terrorist Motivations and Unconventional Weapons," in Peter R. Lavoy, Scott D. Sagan and James J. Wirtz, eds., *Planning the Unthinkable: How New Powers will use Nuclear, Biological, and Chemical Weapons*, (Ithaca, New York: Cornell University Press, 2000), 215-216.

151 Osama bin Laden, "I am Not Afraid of Death," interview with Jamal Ismail, *Newsweek International*, quoted in Bergen, 231.

characterized by loose interconnectivity both within and between groups."[152] Similarly, Marc Sageman concluded the "global Salafi jihad consists of four major clusters surrounded by innumerable islands consisting of cliques and singletons."[153] These networked organizations are highly efficient. "They know how to swarm and disperse, penetrate and disrupt, connect and disconnect, as well as elude and evade."[154] The 9/11 attacks demonstrated this new way of war. During the attacks on New York and Washington, "transnational terrorists, organized in widely dispersed, networked nodes, swarm[e]d together swiftly, on cue, then pulse[d] to attack simultaneously."[155]

Terrorists are not the only potential threat to the U.S. focused on asymmetric strategies. The People's Republic of China "has a long theoretical and historical tradition of seeking asymmetric responses to strategic challenges."[156] Indeed, the Chinese strategist Sun Tzu wrote over two and half millennia ago "[a]ttack him where he is not prepared; go by way of places where it would never occur to him you would go. These are the military strategist's calculations for victory."[157] More recently, the Chinese People's Liberation Army (PLA) has been experimenting with new weapons and tactics, including more agile military formations, more accurate weaponry, and non-lethal weaponry.[158] Additionally, China has focused on networking its command and informational structures. The PLA goal is "to seize information superiority" using a network-centric concept that "emphasizes integrating combat operations by merging command, forces, objectives, and actions."[159] Either state or non-state actors could

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[152] The White House, *National Strategy for Combating Terrorism* (Washington, D.C: The White House, February 2003), 10.

[153] Sageman, 170.

[154] Arquilla and Ronfeldt, 3.

[155] Ibid. For an alternate view of netwar emphasizing the inherent costs of organizing as a network, see Jacob N. Shapiro, "Organizing Terror: Hierarchy and Networks in Covert Organizations," draft paper, Stanford University, 1 November 2005.

[156] Nicholas R. Reisdorff, *Winning the Hundred Battles: China and Asymettric Warfare*, master's thesis (Fort Leavenworth, Kansas: U.S. Army Command and General Staff College, 2003),iii.

[157] Sun Tzu, *The Art of Warfare*, trans. Roger Ames (New York: Ballantine, 1993), 104.

[158] Reisdorff, 51-67.

[159] Timothy L. Thomas, "Chinese and American Network Warfare," *Joint Forces Quarterly*, issue 38 (3rd quarter 2005), 77.

easily adapt the networked mode of attack to the maritime domain. Consequently, any CONOPS for maritime homeland defense must take this into account.

3. Force Effectiveness

Terrorist groups face several operational challenges. Efficiency is difficult to come by when under constant attack from nation-states. Jacob Shapiro of Stanford University has argued that terrorists nearly always suffer from suboptimal performance during government crackdowns.[160] Similarly, insurgency expert J. Bowyer Bell has written extensively on the challenges of operating underground, as all terrorist groups must do if they wish to survive.[161] Additionally, terrorist groups suffer from the same tendency toward entropy common to all organizations. Group must constantly battle this entropy in order to remain effective.[162] Often, groups fail in this endeavor. Terrorist organizations find themselves "subject to a range of influences that may be only tangentially related to its stated strategic objectives."[163] They compete with each other, compounding an inherent action-oriented bias that "encourages taking extreme risks."[164] This bias toward operational risks eventually "begins to interfere with [a terrorist group's] ability to survive."[165]

Some groups, however, overcome these challenges. Al Qaeda was able to develop into a sophisticated transnational terrorist organization largely due to the availability of safe haven in Afghanistan.[166] Asymmetric challenges from state actors will likely possess similar sophistication. Additionally, some non-state groups have found success using suicide bombings. Even though these attacks seem irrational and self-defeating to Westerners, in reality

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160 Shapiro, 25.

161 Bell, 193-211.

162 Jason Bartolomei, William Casebeer, and Troy Thomas, "Modeling Violent Non-State Actors: A Summary of Concepts and Methods," IITA Research Publication 4 (United States Air Force Academy, Colorado: Institute for Information Technology Applications, November 2004), 7.

163 Gordon H. McCormick, "Terrorist Decision Making," Annual Review of Political Science 6 (June 2003), 486.

164 Irving L. Janis and Leon Mann, *Decision Making: A Psychological Analysis of Conflict, Choice, and Commitment* (New York: Free Press, 1977), 130.

165 McCormick, 490.

166 Vali Nasr, Lecture on Islamic Fundamentalism, Naval Postgraduate School, 25 May 2006.

> [s]uicide bombings are inexpensive and effective. They are less complicated and compromising than other kinds of terrorist operations. They guarantee media coverage. The suicide terrorist is the ultimate smart bomb. Perhaps most important, coldly efficient bombings tear at the fabric of trust that holds societies together.[167]

The 9/11 attacks are but the most deadly example of the successful suicide attack strategy. Various non-state groups that overcame the operational challenges of operating underground were also able to learn that suicide terrorism can succeed, sometimes in a spectacular manner.[168] Similarly dedicated suicide forces from a state that engaged in similar asymmetric attacks would yield similar results.

The capabilities-based planning process should take into account the fact that few terrorist groups reach the point where they can seriously threaten the existence of the state. Nonetheless, a small number of state or non-state groups might successfully adapt to the operational challenges of the underground. An effective maritime homeland defense CONOPS must anticipate that these groups will likely use suicide tactics as part of their asymmetric strategy.

4. Environment

The operational environment for maritime defense encompasses more than just the physical characteristics of the maritime domain outlined in chapter one. Any CONOPS for maritime homeland defense also will have to comply with relevant international law. The most relevant international law for maritime homeland defense is Article 51 of the United Nations (UN) charter. Article 51 states that "[n]othing in the present Charter shall impair the inherent right of individual or collective self-defense if an armed attack occurs against a Member of the United Nations, until the Security Council has taken measures necessary to maintain international peace and security."[169]

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[167] Bruce Hoffman, "The Logic of Suicide Terrorism," in Russell D. Howard and Reid Sawyer, *Terrorism and Counterterrorism: Understanding the New Security Environment, Readings and Interpretations* (New York: McGraw Hill, 2003), 260.

[168] Robert A. Pape, *Dying to Win: The Strategic Logic of Suicide Terrorism* (New York: Random House, 2005), 27-61.

[169] United Nations, "Charter of the United Nations – Chapter 7: Action with Respect to Threats to the Peace, Breaches of the Peace, and Acts of Aggression," available from http://www.un.org/aboutun/charter (accessed 29 May 2006).

While Article 51 grants broad authority to UN states for self-defense, the 1982 UN International Law of the Sea (LOS) Convention could place some limits on U.S. freedom of action. This agreement provides for freedom and the seas and innocent passage in order to facilitate international commerce.[170] Although the United States has not yet ratified the LOS Convention,[171] it is still bound by the body of international law relating to the maritime domain. According to Devon Chafee of the Nuclear Age Peace Foundation, the "International Law of the Sea is one of the most comprehensive and well-established bodies of international regulatory norms in existence."[172] The Law of the Sea regime rests on both international norms and treaties, including four 1958 Conventions to which the U.S. is a party. This body of law "grants several freedoms, including the right to navigation on the high seas and rights to transit through international straits, exclusive economic zones (EEZ), and the territorial and archipelagic waters of another state."[173] Maritime defense CONOPS must be sensitive to these legal requirements and obligations of the United States.

One of the reasons nations developed international law for the maritime domain is their common interest in facilitating global commerce. The U.S. government shares this interest. As the *National Security Strategy* states, a "strong world economy enhances our national security by advancing prosperity and freedom in the rest of the world."[174] More explicitly, the *National Strategy for Maritime Security* begins with the statement that the "safety and economic security of the United States depends upon the secure use of the world's oceans."[175] Finally, the MOTR plan directs that all federal agencies "consider appropriately the strategic importance of international trade, economic cooperation, and

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[170] United Nations, "United Nations Convention on the Law of the Sea," available from http://www.un.org/Depts/los/ convention_agreements/texts/unclos/closindx.htm, accessed 25 May 2006.

[171] United Nations Division of Ocean Affair and Law of the Sea, "Status of the United Nations Convention on the Law of the Sea,"28 April 2006, available from http://www.un.org/ Depts/los/reference_files/status2006.pdf (accessed 25 May 2006).

[172] Devon Chaffee, "Freedom or Force on the High Seas? Arms Interdiction and International Law," online article (Nuclear Age Peace Foundation, 15 August 2003), available from http://www.wagingpeace.org/articles/ 2003/08/15_chaffee_freedom-of-force.htm (accessed 25 May 2006).

[173] Ibid.

[174] *National Security Strategy*, 17.

[175] *National Strategy for Maritime Security*, ii.

the free flow of commerce" in planning threat response."[176] Thus, maritime commerce is a critical dimension of the design space for maritime homeland defense CONOPS development.

5. Design Space

By examining each of the above factors, planners gain a more complete understanding of the relevant considerations for CONOPS development. Graphically depicting these considerations provides a tool for quickly visualizing the issues maritime defense CONOPS must consider. Figure 4 visually communicates that the most effective maritime homeland defense CONOPS must simultaneously account for several non-traditional dimensions of the mission. Joint and interagency cooperation will be at a premium. Rules of engagement may be ambiguous. Planners must also account for a networked and adaptive enemy with potential WMD capability. This threat may engage in asymmetric tactics, possibly including suicide operations, to meet their objectives. To make matters even more complicated, while countering this threat, it is in the U.S. government's interest to fully comply with international laws and to protect global commerce.

In order to be effective, the maritime homeland defense CONOPS must address each and every dimension of this design space. The most effective CONOPS would account for all the considerations resident in each dimension. Viewing the design space Figure 4, maritime homeland defense reveals itself as a complex mission with a multitude of considerations and high degree of uncertainty. These characteristics of the design space demand a flexible CONOPS and force structure for maritime homeland defense.

[176] *Maritime Operational Threat Response for the National Strategy for Maritime Security*, 5.

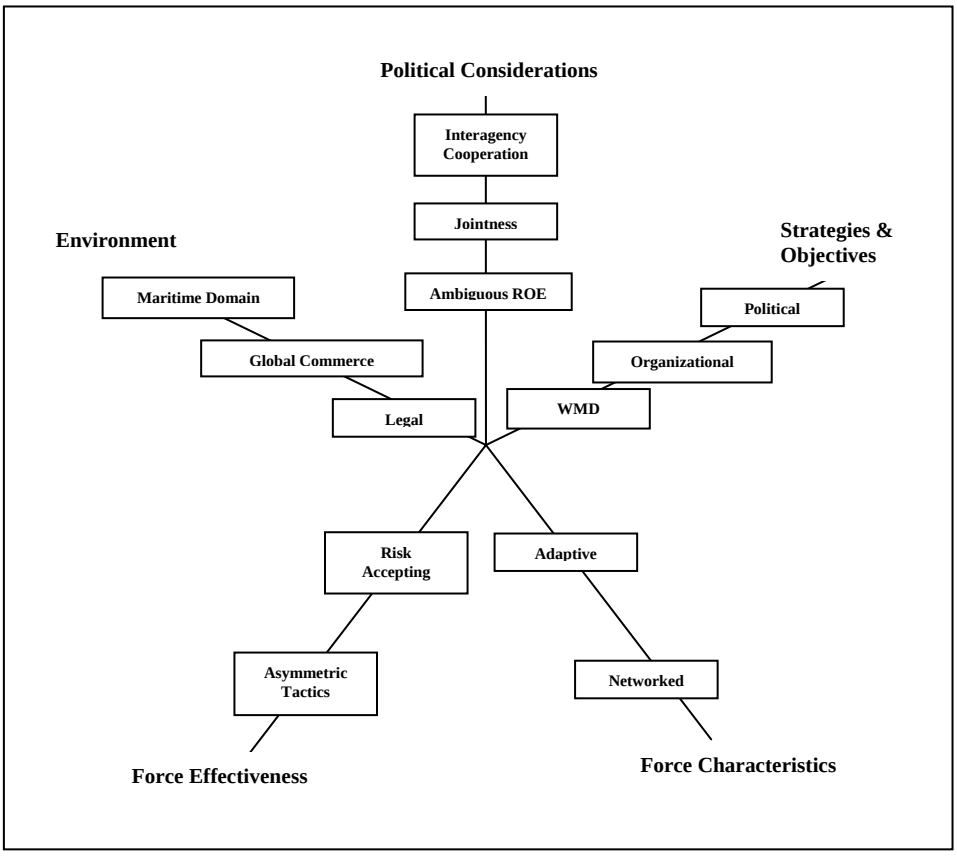

Figure 4. Maritime Homeland Defense Design Space

E. CONCLUSION

The next step in the capabilities-based planning process is to use a concept of operations (CONOPS) to determine what capabilities are needed for maritime homeland defense. To make this determination, the Find→Fix→Track→Target→Engage→Assess (F2T2EA) description of the "kill chain" provides a useful construct. Therefore, the next chapter of this thesis will examine each step in this kill chain, taking into account the limitations imposed by the design space and the full spectrum of threat scenarios discussed above. Enumerating the capabilities required to perform each step in the maritime defense kill chain and comparing these requirements to current capabilities will reveal any existing gaps in DoD's capability to perform maritime homeland defense. Policy options analysis will then determine whether or not air power is an effective or efficient means of bridging these gaps.

IV. CAPABILITIES GAPS AND POLICY OPTIONS

A. INTRODUCTION

The Find→Fix→Track→Target→Engage→Assess (F2T2EA) construct "mechanizes the operational level 'kill chain'" by providing a list of sequential events required to prosecute any target.[177] For conventional military missions, this is relatively straightforward. In the case of maritime homeland defense, however, using F2T2EA requires an additional level of flexibility due to the increased uncertainty inherent in the asymmetric threat. Nonetheless, using the F2T2EA model (and keeping in mind both design space limitations and applicable threat scenarios) allows planners to identify what capabilities are required to prosecute any particular target. For each step in the F2T2EA chain, this chapter will determine the capabilities required for maritime homeland defense, identify any gaps between those requirements and currently available capabilities, and suggest ways the military can bridge those gaps using surface forces, sub-surface forces, or air power. The chapter will conclude with a discussion of additional issues policymakers must consider when deciding which capability options to pursue.

B. F2T2EA CAPABILITY REQUIREMENTS AND GAP ANALYSIS

A recent MITRE Corporation study of Air Force command and control systems details the F2T2EA process (Figure 5). Definitions for each step in the F2T2EA process are described in the study:

> National assets/resources detect objectives of potential significance (find). These systems identify and determine the location of a target (fix). From this location, tracking systems acquire and monitor the object (track). Dynamic decision-making then directs resources (target), and applies capabilities (engage) in a timely and decisive manner. To assure the desired effect, an assessment (assess) occurs during or after engagement to determine whether the target should be reattacked.[178]

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[177] C. Don Means, Erika Darling, and Janet Perron, "Applying Cognitive Work Analysis to Time Critical Targeting Functionality," MITRE Technical Report MTR 04B0000057 (Bedford, Massachusetts: MITRE Corporation, October 2004), 1-2, available from http://www.mitre.org/work/tech_papers tech_papers_04/ 04_0962/04_0962.pdf (accessed 15 June 2006).

[178] Ibid.

Using these definitions as a baseline, the following sub-sections will examine each step in the engagement chain. Each sub-section will offer an expanded definition for each of these steps that accounts for peculiarities specific to asymmetric homeland defense threats in the maritime domain, identify current capabilities and gaps, and suggest ways to overcome these gaps.

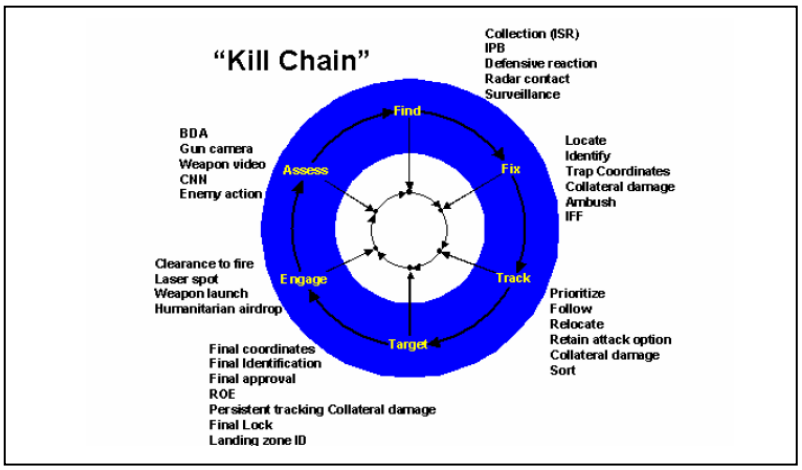

Figure 5. F2T2EA Process (MITRE Corporation)[179]

Throughout the subsequent discussion, it will be useful to remember that there are two basic ways to bridge a capabilities gap. The first and most commonly of these is technological improvement. Development of a new weapon or platform falls into this category. Unfortunately, technological improvement is usually the most expensive and least timely means of resolving capability shortcomings. The second way to bridge a capabilities gap is by using existing technologies or forces in innovative ways. The Air Force did this when it outfitted B-52 bombers with infrared targeting pods, combining long range and precision strike technologies onto one platform for the first time.[180] U.S. Central Command also demonstrated the power of this method when it deployed eleven U.S. Special Forces A-teams to Afghanistan in the fall of 2001. This move represented a shift from the Powell doctrine of overwhelming force, and it enabled the military to collapse the Taliban regime in the span of only a few weeks.[181] This innovative

[179] Means, Darling, and Perron, 1-2.

[180] Mickey McCarter, "B-52 Transformation: Keeping the most versatile bomber in the fleet fresh for the next 37 years," *Military Aerospace Technology* 2, iss. 4, online edition (15 September 2003), available from http://www.military-aerospace-technology.com/article.cfm?DocID=192 (accessed 13 September 2006).

approach to warfare bridged the capability gap imposed by political and geographical constraints that prevented the deployment of large numbers of conventional forces. This chapter will suggest recommendations using both approaches—operational innovation and technological improvement—throughout its discussion of each step in the F2T2EA process.

1. Find

The capability to find a threat tells the military not only where to look, but that it even needs to be looking. The U.S. government must be able to find asymmetric threats before any other steps in the kill chain can occur. Cueing sensors and shooters to fix, target, and engage a maritime threat requires at least general knowledge of its existence. In F2T2EA, "find" equates to detecting the existence of "an objective of potential significance."[182] In the case of maritime homeland defense, ***finding a threat means detecting its existence early enough to allow forces to fix, track, engage, and assess prior to it threatening the homeland***. The definition of "early enough" is contingent upon amount of time required to complete the remaining steps in the kill chain. The U.S. currently uses three main tools to find threats: programs run by U.S. Customs and Border Protection (CBP), an emerging maritime domain awareness (MDA) initiative, and technical intelligence collection capabilities. Each of these tools has inherent strengths and weaknesses.

The first line of defense for finding maritime threats is CBP. The agency's goal is to identify and disrupt terrorist maritime defense schemes before they even start. To this end, CBP has programs in place to ensure it "screens 100 percent of all cargo before it arrives in the U.S using intelligence and cutting edge technologies."[183] For example, through the Container Security Initiative (CSI), CBP and member state customs personnel can examine high risk containerized cargo before it leaves port bound for the

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181 For a discussion of the Afghanistan campaign, see Stephen Biddle, *Afghanistan and the Future of Warfare: Implications for Army and Defense Policy* (Carlisle Barracks, Pennsylvania: U.S. Army War College Strategic Studies Institute, November 2002).

182 Ibid.

183 U.S. Customs and Borders Protection, U.S. Department of Homeland Security, "Securing U.S. Ports," fact sheet, 12 July 2006, available from http://www.cbp.gov/xp/cgov/newsroom/fact_sheets/port_security/securing_us_ports.xml (accessed 17 August 2006).

U.S.[184] Nonetheless, even if CBP was able to implement these initiatives with 100 percent effectiveness, the agency's focus on hazardous or suspicious cargo makes it less likely it would detect other threats, such as unconventional fighters planning to use a ship as a weapon or as a means of infiltration. Furthermore, while a significant number of foreign countries participate in these programs, there are still a large number of ports that do not. A group planning an attack could simply choose to launch its attack from a non-participating port.

In addition to CBP, various other government intelligence and law enforcement agencies collect data that may be pertinent to maritime homeland defense. A recent U.S. Northern Command (NORTHCOM) and Coast Guard conference recognized that DoD, DHS and various other agencies in the U.S. intelligence community all share the responsibility for finding maritime homeland defense threats. Accordingly, the conference called for collecting and analyzing intelligence in a collaborative information environment.[185] The collaborative environment under construction to ensure intelligence fusion and sharing between different organizations is known as maritime domain awareness (MDA).

Homeland Security Presidential Directive HSPD-13 defines MDA as "the effective understanding of anything associated with the global Maritime Domain that could impact the security, safety, economy, or environment of the United States."[186] An effective MDA surveillance system identifies threats by looking for anomalous patterns of behavior and fusing that information with other intelligence, such as that derived from human or technical sources.[187] For example, vessels that failed to comply with standard procedures, vessels operating from non-friendly ports, or vessels crewed by suspect

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[184] U.S. Customs and Borders Protection, U.S. Department of Homeland Security, "Securing U.S. Ports."

[185] Maritime Domain Awareness Remote Sensing Symposium and Regional Data Exchange Conference, "Maritime Security Breakout Session," slide presentation (Rochester, New York: April 2006), available from http://rdx.glc.org/06/presentations/LES_2_Robbins.ppt (accessed 2 October 2006).

[186] President of the United States, "Homeland Security Presidential Directive HSPD-13: Maritime Security Policy," 21 December 2004, available from http://www.fas.org/irp/offdocs/nspd/nspd41.pdf (accessed 17 March 2006).

[187] United States Coast Guard, *National Plan to Achieve Maritime Domain Awareness* (Washington, D.C: Department of Homeland Security, October 2005), ii.

personnel would trigger a flag in the MDA system, prompting a response.[188] Primary responsibility for fusing and analyzing maritime intelligence under MDA belongs to the National Maritime Intelligence Center (NMIC), which includes intelligence elements form the Navy, Marine Corps, Coast Guard, Drug Enforcement Agency, and U.S. Customs.[189] Additionally, the Coast Guard's Maritime Intelligence Fusion Centers (MIFC) for the Pacific and Atlantic coasts can analyze and fuse data from "local and international maritime, intelligence and law enforcement partners."[190]

It is important to remember that there are two parts to the MDA problem: tracking maritime traffic in general and discerning which specific maritime track is a threat. Fusing information on vessels, cargo, and crew members could reveal some maritime defense threats, but it is unlikely to find them all. The asymmetric maritime enemy will seek to maintain his anonymity among the massive volume of legitimate maritime traffic. Discerning which vessel is a threat is a key challenge, similar to other cases of unconventional warfare. Mao Tse Tung famously noted that guerrillas are the "fish" that swim in the "sea" of a country's population.[191] In the case of maritime homeland defense, the "fish" are threat vessels that hide on the actual sea. To defeat all or part of the MDA system, a hostile force merely needs to avoid suspicious behavior. By following all appropriate procedures, operating from friendly (or at least non-enemy) ports, crewing ships with personnel traveling under alias, or stowing away on a ship with a legitimate crew, unconventional bands of fighters could slip under the MDA radar and carry out their mission prior to detection.

Similar limitations exist with respect to technical collection methods. While space-based assets have the advantage of global reach and "avoid international norms for

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188 Department of Homeland Security, *National Plan to Achieve Maritime Domain Awareness for the National Strategy for Maritime Security* (Washington, D.C: Department of Homeland Security, October 2005), 3.

189 Office of Naval Intelligence, National Maritime Intelligence Center, "Our Mission," Fact Sheet, available from http://www.nmic.navy.mil/mission.htm (accessed 14 September 2006).

190 Clare Maranda, "Maritime Intelligence Fusion Center opened," *Pacific Tides*, online edition (U.S. Coast Guard, 1 November 2003), available from http://www.uscg.mil/pacarea/news/ptol/features/MaritimeFusion/ (accessed 14 September 2006).

191 Mao Tse-Tung, *On Guerrilla Warfare*, trans. Samuel B. Griffith (Baltimore, Maryland: Nautical and Aviation Publishing Company of America, 1992), 113.

violating national/sovereign airspace,"[192] they are better suited to finding conventional targets than asymmetric threats. The National Reconnaissance Office (NRO) operates several Advanced KH-11 satellites with optical and infrared imaging capability, as well as several of Lacrosse radar-imaging spacecraft with the ability to "search for evidence of nuclear, chemical and biological weapons development, along with missile production."[193] These satellites "provide . . . coordinated, repetitive image resolutions as good as 4-6 in. during the day and 2-3 ft. or so at night using infrared and radar sensors."[194] Unfortunately, orbital patterns may not meet requirements for persistence, timing, or location in maritime homeland defense. "[M]ost low Earth orbit (LEO) satellites have a specific target in view for less than 10 minutes at a time and revisit the same sites only infrequently."[195] Furthermore, in a conventional maritime battle, signals intelligence (SIGINT) or imagery intelligence (IMINT) can "find" targets of significance: a conventional naval vessel emits various signals making it detectable by SIGINT, and any imagery of the vessel will likely reveal the naval vessel's type if not its specific identification. Against an asymmetric maritime homeland defense threat, however, neither SIGNINT nor IMINT are likely to provide much utility. For example, neither would detect a small group of terrorist stowaways intent on commandeering a vessel in order to use it as a weapon.

As demonstrated above, the capability gaps in the U.S.'s current ability to find maritime threats are significant. CBP programs suffer from their exclusive focus on cargo, and are unlikely to detect plotters intent on using a ship as a weapon or for infiltration. Furthermore, these programs cannot protect the U.S. from threats emanating from non-participating ports, as is likely in the case of state-based or state-sponsored attackers. Unfortunately, the MDA system does not close these gaps, as unconventional

192 Manjeet Singh Pardesi, "Unmanned Aerial Vehicles/Unmanned Combat Aerial Vehicles: Likely Missions and Challenges for the Policy-Relevant Future," *Air and Space Power Journal* XIX, no. 3 (Fall 2005), 51, available from http://www.airpower.maxwell.af.mil/airchronicles/apj/apj05/fal05/fal05.pdf (accessed 4 December 2005).

193 Craig Covault, "Secret NRO Recons Eye Iraqi Threats," *Aviation Week & Space Technology* 157, Iss. 12 (16 September 2002), 23.

194 Ibid.

195 Ed Tomme and Sigfrid Dahl, "Balloons in Today's Military? An Introduction to the Near Space Concept," *Air and Space Power Journal* XIX, no. 4 (Winter 2005), 41-42, available from http://www.airpower.maxwell.af.mil/airchronicles/apj/apj05/win05/win05.pdf (accessed 4 December 2005).

fighters could defeat its ability to find them by avoiding suspicious behavior in order to "blend in" with other maritime traffic. Technical collection means also suffer from their inability to detect unconventional threats. To bridge these capabilities gaps, the U.S. should to focus its efforts in three main areas. First, the U.S. needs to concentrate on various types of human intelligence (HUMINT) sources. Second, the U.S. should make every attempt to penetrate enemy communications. Finally, the U.S. can enhance its technical surveillance capabilities in the maritime domain through the incorporation of air-breathing assets.

HUMINT sources useful for learning of the existence of maritime threats include clandestine, observer, and official sources. Clandestine HUMINT sources that penetrate enemy networks will often have the best visibility into a group's objectives and operational plans. Observer HUMINT sources working in foreign ports can provide critical information on suspicious activities or behaviors that could uncover an asymmetric maritime plot. Official sources—friendly nation intelligence and law enforcement services—will often have the most insight into the activities and intentions of local terrorist groups and neighboring hostile countries. DoD recognizes that "sharing of information and cooperation with allied nations in regards to maritime activities could greatly assist in the early detection and interception of maritime threats."[196] Additionally, as non-state networks become more "diverse and distributed," international information-sharing "will be essential to address the very difficult problem of strategic and tactical warning in relation to new forms of terrorism."[197]

A second area of focus for improving the U.S. ability to find threats in the maritime domain is penetration of enemy communications (COMINT). The government can gain insight into enemy plans and objectives by using technical means to penetrate enemy communications. Terrorist groups use a variety of methods to communicate including cell phones,[198] satellite phones,[199] and the internet.[200] Developing methods for

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196 *HLS JOC*, 21.

197 Ian O. Lesser, "Coalition Dynamics in the War against Terrorism," *The International Spectator* (February 2002), 45, available from http://pacificcouncil.org/pdfs/lesser.pdf (accessed 18 August 2005).

198 Brian Ross and Richard Esposito, "Surge in Sale of Disposable Cell Phones May Have Terror Link," ABC News Investigations, online article, 12 January 2006, available from http://abcnews.go.com/WNT/Investigation/story?id=1499905 (accessed 14 September 2006).

intercepting and exploiting terrorist communications in these domains would significantly enhance the government's ability to detect maritime threats. This should be a major focus area for information warfare operations in cyberspace.

The final area for improving the U.S. ability to find maritime threats is by improving it ability to persistently monitor the maritime domain. Unmanned aerial systems (UAS), manned systems, and near-space platforms all can assist in bridging this capability gap. UAS possess range, altitude, and payload capabilities that make them useful for finding maritime defense threats. For example, the RQ-4A Global Hawk has the capability to "fly 1,200 miles to an area of interest and remain on station for 24 hours."[201] Global Hawk sensors include a synthetic aperture radar (SAR) with ground moving target indicator (GMTI) capability as well as electro-optical (EO) and infrared (IR) cameras. Using these sensors, the RQ-4A "can image an area the size of Illinois (40,000 nautical square miles) in just 24 hours."[202] The Global Hawk radar is reportedly capable of resolutions down to one foot, and the aircraft's GMTI mode is able to track moving vehicles down to four knots, more than adequate for most seaborne vessels. The Global Hawk's EO and IR payload resolution is reportedly as good as .4 meters.[203] Finally, the Global Hawk has already proven itself in the maritime domain, performing sea surveillance during several maritime exercises. In April 2001, the UAS demonstrated its global reach, flying "7,500 miles nonstop across the Pacific to Australia."[204]

Recognizing the potential for UAS in the maritime domain, both the Coast Guard and Navy have programmed future purchases. The Coast Guard plans to buy four

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199 Jack Shafer, "Don't Blame the *Washington Times* For the Osama Bin Laden satellite phone 'leak.'" *Slate* online magazine, 21 December 2005, available from http://www.slate.com/id/2132975/ (accessed 14 September 2006).

200 Gabriel Weimann, *Terror on the Internet: The New Arena, the New Challenges* (Washington, D.C: The United States Institute for Peace, 2006).

201 U.S. Air Force, *Global Hawk Fact Sheet*, October 2005, available from http://www.af.mil/factsheets/factsheet.asp?fsID=175 (accessed 4 December 2005).

202 Ibid.

203 Global Security.org, *Global Hawk (Tier II+ HAE UAV) Fact Sheet*, available from http://www.globalsecurity .org /intell/systems/global_hawk.htm (accessed 4 December 2005). The website identifies resolution as National Image Interpretability Rating Scales (NIIRS) 6 or 5.5. NIIRS definitions can be found at the Federation of American Scientists Intelligence Resource Program website, http://www.fas.org/irp/imint/niirs.htm (accessed 4 December 2005).

204 Ibid.

Mariner aircraft, a derivative of the Predator B, as part of its Integrated Deepwater Initiative.[205] The U.S. Navy's Broad Area Maritime Surveillance (BAMS) program has a requirement for "enough systems to cover five major areas of the world 24 hours a day, year round."[206] Although the Navy has not further quantified the number of UAS it plans to purchase, estimates suggest BAMS will "require dozens of aircraft and associated systems that could cost more than $50 million each."[207]

Manned aircraft also offer a capability to find maritime defense threats. Although precise details are classified, the manned U-2 reconnaissance aircraft reportedly has an EO imaging capability of 120 km, a radar imaging capability of 180 km, and a SIGNIT capability out to 280 km.[208] Additionally, although primarily known for its ability against ground targets, the E-8C Joint STARS has a potential maritime search and track capability as well.[209] The E-8 radar field-of-view covers over 19,000 square miles and can detect targets over 250 km away.[210]

Near-space platforms (usually a rigid airship or blimp) operating above 75,000 feet and below 62.5 miles offer a way to significantly increase maritime surveillance capability. In part, this is because near space platforms are more persistent that space-based assets, UAS, or manned aircraft. Additionally, because these platforms "are 10–20 times closer to their targets than a typical 400-kilometer LEO satellite" they "can be 10–20 times smaller for similar performance, or the same size optics can get 10–20 times better resolution."[211] Once on station, these platforms "can stay for a very long time,"

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[205] U.S. Coast Guard, *High Altitude Endurance Unmanned Air Vehicle (HAEUAV) Fact Sheet*, 2 February 2006, available from http://www.uscg.mil/deepwater/system/hauav.htm (accessed 18 August 2006).

[206] Otto Kreisher, "Two S.D. firms could be competing for Navy contract: BAMS is called huge undertaking," *San Diego Union-Tribune*, online article, 18 May 2006, available from http://www.signonsandiego.com/uniontrib/20060518/news_1b18bams.html (accessed 18 August 2006).

[207] Ibid.

[208] FAS.org, *SENIOR YEAR / AQUATONE / U-2 / TR-1 Fact Sheet*, available from http://www.fas.org/irp/ program/collect/u-2.htm (accessed 18 August 2006).

[209] Global Security.org, *E-8 Joint-STARS Improvements and Upgrades*, 26 March 2004, available from http://www.globalsecurity.org/intell/systems/jstars-up.htm (accessed 5 October 2006).

[210] U.S. Air Force, *E-8C Joint Stars Fact Sheet*, October 2005, available from http://www.af.mil/factsheets/ factsheet.asp?fsID=100 (accessed 5 October 2006).

[211] Tomme and Dahl, 43.

conceivably up to six months or more.[212] Furthermore, because of their extreme altitude near-space assets have an extremely wide field of view. At 120,000 feet a near-space platform would have a footprint 1,700 miles in diameter.[213] Finally, near-space platforms are relatively cost effective. According to a spokesman the U.S. Air Force Space Battlelab project, at a cost of $500,000 for each 175-foot long near-space airship, "[y]ou could probably roll about 40 of these off the line for the price of one Global Hawk."[214] Thus, near-space assets have the potential to contribute significant amounts of information to the MDA picture in a cost effective manner.

2. Fix and Track

Determining the location of a target, then acquiring and monitoring it, comprise the fix and track portions of F2T2EA. For maritime homeland defense, the fix and track steps equate to ***geospatially locating the target over time with adequate fidelity for maritime interception and/or interdiction.*** Without precise geo-location of a given target, subsequent steps in the kill chain are not possible.[215] The difficulty of this task is directly related to the quality of intelligence. In the best case scenario, intelligence will identify a specific vessel of concern, at which point commanders can task assets to fix its location and track it. In other scenarios, however, fixing and tracking a threat vessel will require the capability to determine which ship among many is the actual threat to the homeland. Currently the military depends on a combination of spaced-based and surface/sub-surface naval assets to fix and track maritime vessels of interest.

Space-based assets can be useful for fixing and tracking maritime homeland defense threats. Unfortunately, however, due to their high-cost these assets generally are not ordered to support any single operation. Instead, "requirements usually exceed

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[212] Tomme and Dahl, 48.

[213] Ibid., 44.

[214] Major Robert Blackington, U.S. Air Force Space Battlelab project, quoted in Alan Boyle, "Airship groomed for flight to edge of space: Developer says 'baby steps' will someday lead to orbit," MSNBC online article, 21 May 2004, available from http://www.msnbc.msn.com/id/5025388/ (accessed 14 September 2006).

[215] John A. Tirpak, "Find, Fix, Track, Target, Engage, Assess," *Air Force Magazine* 83, no. 7 (July 2000). Available from http://www.afa.org/magazine/July2000/0700find_print.html (accessed 15 June 2006).

platform capabilities and inventory."[216] When this is the case, space-based assets "may not be readily available to operational or tactical commanders."[217] Additionally, while space-based assets might be able to fix a target's location at a particular point in time, these systems lack the ability to persistently track a target over time. This limitation was evident during the build-up to Operation Iraqi Freedom (OIF). During this time period, six satellites tasked exclusively against the Baghdad regime resulted in only twelve overflights with viewing angles capable of providing "the highest resolution pictures."[218] Thus, these space-based systems provide only limited capability required to fix and track targets in the maritime domain.

U.S. Navy submarine and surface vessels have significant fixing and tracking capabilities. Typical of submarine surface search radars is the AN/BPS-15. This X-band radar has a range resolution of 10-30 meters (depending on operating mode), more than adequate for maritime homeland defense purposes.[219] Additionally, most U.S. naval surface surveillance radars have detection capabilities of between 100 and 200 km with comparable resolution, providing yet another fix and track option for maritime defense.[220]

The United States reportedly used a combination of space-based and U.S. Navy surface vessel tracking in December 2002 against the *So San*, a North Korean vessel traveling between the reclusive Pyongyang regime and Yemen carrying a cargo of Scud missiles.[221] This fixing and tracking of the *So San* mirrors the capability required for non-traditional maritime defense fixing and tracking. It is important to note, however, that U.S. intelligence provided advanced knowledge of the *So San* prior to its departure from North Korea. This knowledge would have enabled the U.S. Navy to position ships in an appropriate area for tracking the vessel once it departed for Yemen. In other

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[216] U.S. Department of Defense, *Joint Publication 2-01: Joint and National Intelligence Support to Military Operations* (Washington, D.C: U.S. Department of Defense, 7 October 2004.

[217] Tomme and Dahl, 40-41.

[218] Ibid.

[219] Martin Streetly, ed., *Jane's Radar and Electonic Warfare Systems 2005-2006*, 17th ed. (Alexandria, Virginia: Jane's Information Group, 2005), 150.

[220] Ibid., 154 – 158.

[221] Thomas E. Ricks and Peter Slevin, "Spain and U.S. Seize N. Korean Missiles: Scuds Were on Ship Bound for Yemen," *Washington Post*, 11 December 2002, A01.

scenarios, naval vessels may or may not be able to get into a similarly advantageous position due to their limited numbers and the relatively limitless size of the maritime domain.

Another significant difference between the *So San* episode and certain maritime homeland defense scenarios is that in the *So San* case, intelligence provided a specific vessel as a target to fix and track. In maritime homeland defense, however, intelligence may only indicate the existence of a threat without precise information on the specific vessel. In this case, intelligence may only know general information on the timing of the threat or its presumed target. For example, a foreign intelligence service might inform the U.S. government that it has credible information a group of terrorists stowed away on a vessel bound for the West coast sometime in the last forty-eight hours. More precise information on the type of vessel may or may not be available, leading to a high number of suspect vessels.[222]

Standoff sensors, whether space-based, air-breathing, surface or subsurface will have only limited utility under these circumstances. Few if any external indicators will exist that distinguish the actual threat vessel from surrounding suspect vessels. A vessel being used as a launch platform conceivably could have some visual or emission-based distinguishing features, but it is just as likely no such features will exist at all. Similarly, on-board explosives or WMD might or might not be visible via spectral or air-sample analysis. Cases where a band of unconventional fighters is on-board a vessel (with the intent to commandeer it or use it to infiltrate personnel) are also problematic. Except in cases where members of the group foolishly expose themselves (either to visual observation on the vessel surface or through some type of exploitable communications link such as satellite phone), stowaway groups of fighters will likely remain undetected and undetectable from standoff sensors.

When standoff sensors are inadequate to fix a threat vessel's location, DoD will require the capability to board and inspect suspect vessels. Coast Guard Law Enforcement Detachments (LEDETs, see Chapter III) are an appropriate tool for this

[222] A scenario similar to this was recently analyzed by the Meyer Institute for Systems Engineering a the Naval Postgraduate School. See LCDR Andrew Kessler, *et al*, *Maritime Threat Response*, Final Report (Monterey, California: Naval Postgraduate School, June 2006), 30-31.

mission. Similarly, the U.S. Navy and Marine Corps both maintain a robust visit, board, search, and seizure (VBSS) capability.[223] For example, SEAL teams can conduct either overt of covert VBSS, using helicopters, surface, or subsurface insertion methods.[224] Nonetheless, the use of boarding parties has limitations. Recent modeling of various maritime defense scenarios at the Naval Postgraduate School found two significant shortcomings in the military's current capability to deliver boarding parties to suspect vessels. First, with timely and specific intelligence the U.S. Navy had the ability to deliver boarding parties to suspect vessels with adequate inspection time. Most scenarios resulted in a requirement to board and search approximately twenty vessels. Late intelligence warning, however, resulted in an inadequate amount of time to inspect all the suspect ships. Second, a simultaneous attack from multiple ports increased the number of vessel boarding requirements, which also overwhelmed current capabilities.[225] In both of these instances, the size of the maritime domain made it impossible to move limited boarding forces with the requisite speed to meet operational requirements.

As the discussion above highlights, the U.S. military currently has two major gaps in its capability to fix and track maritime homeland defense threats. The first of these is an inability to rapidly respond over a large distance in order to fix and track the location of specific vessels. The second is a limited ability to determine which vessel among many suspects is the actual hostile threat to the homeland. The military can bridge these gaps by using long-range UAS and manned aircraft for sea surveillance and by developing faster means for the delivery of boarding parties.

The range and speed of UAS makes them extremely useful in scenarios requiring rapid response over long distances against identified (or identifiable) threats. The RQ-4 Global Hawk has the range and payload to fix a target's location almost anywhere on the globe. Indeed, U.S. commanders used these impressive capabilities with great effect during OIF. Although Global Hawk "accounted for only 5 percent of intelligence sorties

[223] Ray Bethell and Barbara Bradley, "Hostile visit, board, search and seizure training 'takes down' the bad guys," *The Weaponeer* (21 December 2000), available from http://www.nawcwpns.navy.mil/ ~pacrange/s1/news/ 2000/Hostile.htm (accessed 15 June 2006).

[224] "Maritime Boarding SEAL Style," online article, available from http://www.specwarnet.net/ miscinfo/SEALboard.htm (accessed 15 June 2006).

[225] LCDR Andrew Kessler, *et al*, *Maritime Threat Response*, Final Report (Monterey, California: Naval Postgraduate School, June 2006), 30-31, 252.

[in OIF], it produced 50 percent of the information on time-sensitive targets."[226] The MQ-1 Predator may also meet maritime homeland defense requirements. This UAS has a range of 400 NM and is equipped with a day variable-aperture TV camera, a variable-aperture infrared (IR) camera, and a synthetic aperture radar (SAR) known as the Lynx.[227] "In spotlight mode from an altitude of 25,000 ft., the Lynx can produce 1-ft.-resolution imagery at standoff distances of up to 35 miles."[228] In inclement weather, the radar has 4-inch resolution at ranges up to 16 miles.[229] All three sensors can produce still pictures, and the two cameras can also produce full motion video.[230] With loiter times of approximately 14 hours, the MQ-1 is ideally suited to medium range ISR missions.[231] An updated version of this aircraft, the MQ-9 Predator B, has increased payload, a higher operating altitude, and the ability to loiter for up to 32 hours.[232] Both the Predator and Predator B can fly above visual or aural detection ranges (25,000 feet and 50,000 feet respectively), making them ideal choices to shadow and track suspect vessels.

Manned aircraft also offer capabilities applicable to fixing and tracking known maritime threats. Most fighter and bomber aircraft can use radar to generate high-quality targeting information on surface tracks.[233] Many have IR and TV targeting capabilities as well.[234] While these latter capabilities have limited applicability for broad area search, once cued to a target's general location they can aid in target identification. For example,

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[226] Thomas Donnelly and Michael Vickers, *Iraq: Lessons Learned*, American Enterprise Institute, 8 December 2003, available from http://www.aei.org/events/filter.,eventID.337/summary.asp (accessed 4 December 2005).

[227] U.S. Air Force, *MQ-1 Predator Unmanned Aerial Vehicle Fact Sheet*, October 2005, available from http://www.af.mil/factsheets/factsheet.asp?id=122 (accessed 4 December 2005).

[228] "Gnat Exploits Advanced SAR," *Aviation Week & Space Technology* 151, Iss. 10 (6 September 1999), 24.

[229] Ibid.

[230] U.S. Air Force, *MQ-1 Predator Unmanned Aerial Vehicle Fact Sheet*.

[231] Global Security.org, *RQ-1 Medium Altitude Endurance (MAE) UAV Fact Sheet*, available from http://www.globalsecurity.org/intell/systems/predator.htm (accessed 4 December 2005).

[232] Global Security.org, *MQ-9A Predator B Fact Sheet*, available from http://www.globalsecurity.org/intell/systems/predatorb.htm (accessed 4 December 2005).

[233] For example, Robert Wall, "F/A-18E/F Radar Upgrade Readied," *Aviation Week & Space Technology* 157, Iss. 26 (23 December 2002), 57; and "Two bombers participating," *Aviation Week & Space Technology* 164, Iss. 20 (15 May 2006), 18.

[234] Andrew Dardine, "Avionics in Demand," *Aviation Week & Space Technology* 164, Iss. 3 (16 January 2006), 203.

the IR/TV capable Sniper advanced targeting pod has a "'recognition range' 2-3 times longer than that of legacy targeting pods."[235] With the Sniper pod at 15,000 feet, it is possible to count numbers of personnel and identify vehicle types.[236] Additionally, the U.S. Navy's P-3 aircraft and the future multi-mission maritime aircraft (MMA), scheduled for service in 2010, both have a maritime fixing and tracking capability.[237]

In cases where boarding parties are required to determine whether or not a vessel is hostile, the greatest need is for a more rapid boarding party delivery capability. Typical naval vessels move at a top speed of only 20-22 knots. Any time enroute to a suspect vessel is wasted since the boarding party is inactive during that period. With a top speed of in excess 45 knots, the Littoral Combat Ship (LCS) partially bridges this capability gap. The LCS is designed around concepts similar those used in the development of submarine chasers. These unique vessels use hydrofoils to lift them above the water, allowing them to skim the surface at high speeds.[238] The Navy plans to purchase 55 LCS.[239] In modeling of single-axis, single-vessel attack scenarios, the increased speed of the LCS made a significant difference. The ability of the LCS to deliver boarding parties to the target ship sooner either decreased the number of boarding teams required (since the same team can leapfrog through a series of suspect vessels) or, alternatively, increased the search time per vessel available to the teams.[240] Still, even with approximately thirty LCS optimally stationed throughout the Pacific for homeland defense, a swarming multi-axis maritime attack quickly overwhelmed the U.S. response. A simultaneous or near-simultaneous attack from the Atlantic would exacerbate this problem. Although the Navy's goal is to maintain a cost ceiling of $220 million per LCS,

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[235] William B. Scott, "Nowhere to Hide," *Aviation Week & Space Technology* 161, Iss. 13 (4 October 2004), 52.

[236] David A. Fulghum, "Sensor Success," *Aviation Week & Space Technology* 162, Iss. 21 (23 May 2005), 55.

[237] Globalsecurity.org, *P-3 Orion Fact Sheet*, available from http://www.globalsecurity.org/military/systems/aircraft/p-3.htm (accessed 18 August 2006), and *P-8 Multimission Maritime Aircraft (MMA) Broad Area Maritime Surveillance Fact Sheet*, available from http://www.globalsecurity.org/military/systems/aircraft/mma.htm (accessed 18 August 2006).

[238] United States Navy, Naval Sea Systems Command, "Dynamic Lift Vehicles," online directory, available from http://www50.dt.navy.mil/toc.html (accessed 15 September 2006).

[239] Ronald O'Rourke, *Navy Littoral Combat Ship (LCS): Background and Issues for Congress*, CRS Report to Congress, RS21305 (Washington, D.C: Library of Congress, updated 18 August 2006), 2.

[240] Kessler, *et al*, 250-251.

the Congressional Research Service predicts costs could rise to as high as $387 million.[241] This cost makes the acquisition of additional LCS for maritime homeland defense unlikely.

While the LCS partially answers the need for more rapid boarding party delivery, a true long-range and rapid response capability requires aircraft. The H-53 series helicopters have a top speed of approximately 165 knots, nearly four times the speed of the LCS and eight times faster than current vessels. Although the range of the H-53 helicopters is limited to 600 miles, this can be extended by aerial refueling.[242] Ship or shore launched H-53 aircraft could deliver boarding teams to suspect vessels, although shore launched operations would require multiple air refueling points. The Navy and Marines use their CH-53 variants for the transport of equipment, supplies and personnel in support of amphibious operations. The Air Force's MH-53 variant is dedicated to special operations. Imposing an alert requirement for aircraft and crews would take resources away from these missions. The logical choice for this mission is the Navy's and Marine Corps' approximately 200 CH-53. Using Navy and Marine assets would maintain the traditional roles and missions that give the Navy responsibility for the maritime domain and simplify command relationships.

Another option is the MH-60 helicopter, with a range of 380 nautical miles and speed of 145 knots. Importantly, the LCS is equipped with a helicopter deck configured for the MH-60.[243] Using the LCS (other vessels are also an option) to ferry boarding teams to within helicopter ranges and then using the helicopter for the final delivery of the team would provide an additional four hours time for VBSS operations. The Navy currently plans to use the MH-60 for surface and subsurface warfare support, search and

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[241] Ronald O'Rourke, *Navy Littoral Combat Ship (LCS): Background and Issues for Congress*, CRS Report to Congress, RS21305 (Washington, D.C: Library of Congress, 24 June 2005), 2.

[242] U.S. Air Force, *MH-53J/M Pave Low Fact Sheet*, October 2005, available from http://www.af.mil/factsheets/factsheet.asp?id=117 (accessed 4 December 2005).

[243] *Sikorsky SH-60 Seahawk Fact Sheet*, available from http://www.answers.com/topic/sikorsky-sh-60-seahawk (accessed 15 September 2006).

rescue, naval special warfare, and logistics,[244] although it is also considering maritime defense missions for the aircraft. These include using the MH-60 to deliver boarding teams with rigid hull inflatable boats, building on the Navy's past experience with helicopter VBSS.[245]

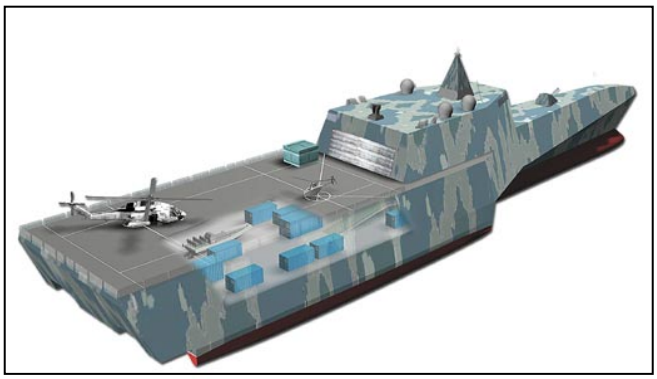

Figure 6. LCS Design with Helicopter Pad (General Dynamics)

One final option for increasing the military's ability to rapidly deliver boarding parties over long distances is the V-22 Osprey. The Air Force and Marine Corps currently are testing their respective versions of the V-22, a tilt-rotor aircraft that can takeoff like a helicopter then tilt its rotors forward to cruise like a fixed-wing aircraft. Although the V-22's unrefueled range is similar to the H-53 series helicopters, it has an increased cruising speed of approximately 250 knots.[246] Using a V-22 variant instead of a helicopter to effect final delivery of a boarding party would provide nearly five additional hours for VBSS operations over surface-based options. Furthermore, V-22's launched from land bases with aerial refueling support could deliver boarding parties several times faster than surface vessels. Nonetheless, surface-based logistic support would still be desirable, especially in scenarios requiring multiple boardings. It would be much more efficient for land-based V-22s to recover to surface vessels after delivering a boarding party instead of having to fly all the way back to their launching station.

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[244] United States Navy, *Naval Aviation Vision 2020* (Washington, D.C: U.S. Department of the Navy, no date), 52-54.

[245] Frank Colucci, "Navy, Marine Helicopter Fleets Will See Steady Arrivals of New Aircraft," *National Defense*, online edition (September 2005), available from http://www.nationaldefensemagazine.org/issues/2005/Sep/Navy_Marine.htm (accessed 15 September 2006).

[246] Christopher Bolkcom, *V-22 Osprey Tilt-Rotor Aircraft*, CRS Issue Brief for Congress, IB86103 (Washington, D.C: Library of Congress, updated 5 November 2001), 2.

Current procurement plans call 348 Marine Corps MV-22, 50 Air Force CV-22, and 48 Navy HV-22. Marine Corps variants will perform the heavy lift mission, replacing older helicopters. The Air Force variant is slated for special operations. The Navy will use its HV-22s for search and rescue and logistics.[247] Adding the mission of maritime defense to any of the services would require additional aircraft purchases at a cost of $40.1 million each. Still, initial response and delivery of boarding teams using the Osprey would do much to enhance U.S. fix and track capabilities for the maritime homeland defense mission.

Figure 7. V-22 Osprey Fast Rope Test (USMC)

3. Target and Engage

Under the F2T2EA construct, targeting implies a decision-maker directing resources against an objective, and engaging consists of applying capabilities against the objective "in a timely and decisive manner."[248] While the military traditionally has viewed the application of overwhelming force as the appropriate way to target and engage the enemy, the maritime homeland defense requirement is more nuanced. The military needs capabilities that support ***a full-spectrum of rapid response options, from minimal non-lethal force to the ability to disable or destroy a threat vessel***. In the context of maritime homeland defense, both lethal and non-lethal force capabilities may be appropriate, and either could be applied from surface, sub-surface, or air-breathing

[247] United States Marine Corps, *MV-22 Osprey Fact Sheet*, 30 December 1997, available from http://www.hqmc.usmc.mil/factfile.nsf/0/006111164d72c407852562de00720540?OpenDocument (accessed 15 September 2006).

[248] Means, Darling, and Perron, 1-2.

assets. Current military target and engagement capabilities are biased towards the lethal end of the spectrum, with boarding parties the only non-lethal engagement option.

Most naval vessels are designed to apply lethal force against maritime threats. The RGM-84/UGM-84 Harpoon is a surface-launched missile designed for just such purposes, and can be carried by most naval ships.[249] Additionally, naval surface and subsurface vessels are capable of launching a number of different torpedoes against other vessels.[250] Nonetheless, surface vessels lack the speed of aircraft, severely limiting their geographic coverage during a given time period. Aerial-refueled fighters, long range bombers, or UAS platforms potentially provide the rapid lethal response capability over large distances that surface and sub-surface vessels cannot.

Through the Affordable Moving Surface Target Engagement (AMSTE) program, the Air Force recently adapted the Joint Direct Attack Munition (JDAM), a Global Positioning System (GPS) guided weapon, for engagement of both maritime and ground moving targets. After release from an aircraft, the AMSTE-equipped JDAM receives updates on a target's location from aircraft equipped with GMTI-capable radar.[251] In November 2004 a B-52 flew non-stop from Guam and successfully employed AMTSE-equipped JDAM against the decommissioned USS *Schenectady* (LST 1185), destroying the vessel offshore from Hawaii.[252] The Air Force demonstrated a similar capability in June 2005 when B-1B bombers successfully dropped CBU-97, a guided cluster munition known as the sensor-fuzed weapon, on a moving maritime target in the Gulf of Mexico.[253] Other weapons are also available to destroy moving targets, including the

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[249] E. R. Hooton, ed., *Jane's Naval Weapon Systems* 44 (2006), 354.

[250] Ibid., 495-511.

[251] *Space Daily*, "Ground Moving Target Engagement System Hits Tank with JDAM," 22 December 2003, available from http://www.spacedaily.com/news/gps-03zzh.html (accessed 4 December 2005).

[252] Tonya Keebaugh, "Resultant Fury Successful Thanks to 'Test' Airmen," *Air Force Print News*, 14 December 2004, available from http://www.af.mil/news/story_print.asp?storyID=123009411 (accessed 4 December 2005).

[253] Kiley Olds, "Dyess AFB Demonstrates B-1B's Upgrades, Combat Capabilities," *Air Force Print News*, 19 August 2005, available from http://www.af.mil/news/story_print.asp?storyID=123011369 (accessed 4 December 2005).

AGM-65 Maverick and AGM-114 Hellfire missiles.[254] Finally, the Navy's P-3, S-3, and F/A-18 aircraft and the Air Force's B-52 bomber are all capable of carrying the AGM-84D Harpoon anti-ship missile.[255]

Figure 8. USS *Schenectady* being sunk by JDAM from a B-52 aircraft (USAF)

Destroying a vessel is only the option of last resort, however. Policymakers are not likely to approve such actions without perfect intelligence, a chimerical commodity. Thus, the largest gaps in the ability to target and engage facing the U.S. military are a lack of non-lethal or ship-disabling weaponry. A second capability gap becomes apparent in scenarios where intelligence indicates that an attack is in progress but not its origin or target. These cases are problematic because, in effect, every ship becomes suspect. These scenarios indicate the need for a flexible, last-minutes response capability.

The first way to improve the military's capability to apply non-lethal forces is through faster delivery of boarding teams. These teams are themselves a potentially non-lethal or ship-disabling weapon. After fixing the target's location, boarding parties can

[254] U.S. Air Force, *AGM-65 Fact Sheet*, October 2005, available from http://www.af.mil/factsheets/factsheet.asp?fsID=72 (accessed 17 March 2006); and U.S. Air Force, *MQ-1Predator Unmanned Aerial Vehicle Fact Sheet*, October 2005, available from http://www.af.mil/factsheets/factsheet_print.asp?fsID=122&page=1 (accessed 17 March 2006).

[255] FAS.org, *AGM-84 Harpoon Fact Sheet*, 1 December 2005, available from http://www.fas.org/man/dod-101/sys/smart/agm-84.htm (accessed 18 August 2006).

use the minimum required force to subdue a threat. Accordingly, the LCS, helicopter, and V-22 options for rapid and long-range boarding team delivery would also add capability for the target, engage, and assess steps in the kill chain.

In certain scenarios it may not be possible to insert a boarding party. For example, a non-cooperative vessel might maneuver to imperil the lives of the VBSS party during their boarding attempts. Additionally, the use of small arms or man-portable missiles can threaten air- and surface-based insertion methods. In this latter case, rules of engagement may allow for declaration of a vessel as a hostile force, implying kill authority. In the former however, non-compliance without hostile behavior may result from the crews' desire to conceal illegal activities (e.g., smuggling) rather than their intent to carry out an act of war.

These considerations suggest that the ability to disable a vessel is extremely valuable in the maritime homeland defense mission. Commanders could authorize the disabling of a vessel long before it approach the U.S. coast, neutralizing any potential threat to the homeland without destroying the vessel, without destroying any evidence on board, and without killing noncombatants. Once the threat was dead was the water, there would be adequate time to dispatch a boarding team to further investigate. A ship-disabling capability would solve the problems associated with less time or less actionable intelligence as well as the problem of defending from a multi-axis swarming attack. Additionally, utilizing a non-lethal or ship disabling capability would better comport with the maritime defense requirements to protect global commerce and adhere to peacetime international law.

The most effective way to disable a ship is to neutralize its propulsion or steering system. Accordingly, a small warhead kinetic weapon that homes on a ship's screws would be an appropriate attack method. While generally conceived as gun employment from surface vessels,[256] aircraft could also employ gunfire against critical nodes of a ship and disable it. One highly accurate and destructive weapon currently available is the AC-130 gunship. The AC-130 "incorporate[s] side-firing weapons integrated with sophisticated sensor, navigation and fire control systems to provide surgical firepower or

[256] Kessler, *et al*, "Maritime Threat Response Project Outbrief."

area saturation during extended loiter periods, at night and in adverse weather. The sensor suite consists of a television sensor, infrared sensor and radar."[257] With this extremely accurate fire control system, "the AC-130 can place 105mm, 40mm and 25mm munitions on target with first round accuracy."[258] Fighter and attack aircraft employing strafe are another option. In general, however, the accuracy of gunfire from a fighter/attack aircraft is somewhat less that that from a gunship. With fixed gun positions and limited systems to assist in cueing, fighter/attack strafe accuracy depends primarily on visual acquisition of the target and the pilot's gunnery skills.

Another option for disabling a ship is the use of non-kinetic weapons. The Coast Guard has experimented with non-explosive devices for fouling propulsion or steering systems, including both surface- and air-delivered entanglement systems. Devices to date have focused on small boats.[259] The Joint Non-Lethal Weapons Program (JNLWP) is examining future entanglement devices,[260] but these devices are of questionable use against large ocean-going vessels. Instead, JNLWP is studying the applicability of non-lethal and less-lethal directed energy weapons for the maritime defense mission.[261]

The military should also consider non-nuclear electromagnetic pulse (EMP) weapons. These devices produce a short but intense electromagnetic pulse, "sufficiently strong to produce short lived transient voltages of thousands of Volts [and] can result in irreversible damage to a wide range of electrical and electronic equipment, particularly computers and radio or radar receivers."[262] Any vessel that depended on these systems

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[257] U.S. Air Force, *AC-130H/U Gunship Fact Sheet*, October 2005, available from http://www.af.mil/factsheets/factsheet.asp?fsID=71 (accessed 15 September 2006).

[258] FAS.org, *AC-130H Spectre/AC-130U Spooky Fact Sheet*, 8 January 2000, available from http://www.fas.org/man/dod-101/sys/ac/ac-130.htm (accessed 15 September 2006).

[259] U.S. Coast Guard, "Non-Lethal Weapons in Law Enforcement Briefing" (Washington, D.C: U.S. Coast Guard, 2002), available from www.dtic.mil/ndia/2002nonlethdef/Jacobs.pdf (accessed 15 September 2006).

[260] Doug Beizer, "DOD taps American Systems for nonlethal weapons work," GCN.com online article, 6 January 2006, available from http://www.gcn.com/online/vol1_no1/37919-1.html?topic=defense-technology (accessed 15 September 2006).

[261] LCDR Cabot Aycock, Joint Non-lethal Weapons Program, *Mission Briefing* (Monterey, California: Joint Non-Lethal Weapons Program, 30 October 2006).

[262] Carlo Kopp, "The Electromagnetic Bomb - a Weapon of Electrical Mass Destruction," *Air & Space Power Journal - Chronicles Online Journal* available from http://www.airpower.maxwell.af.mil/airchronicles/kopp/apjemp.html (accessed 15 September 2006).

for navigation would be inherently vulnerable. Additionally, EMP technology for bomb designs is relatively mature. The Los Alamos National Laboratory first demonstrated EMP weapons in the 1950s. "Since that time a wide range of [EMP weapon] configurations has been built and tested, both in the US and the [Soviet Union], and more recently CIS [Commonwealth of Independent States]."[263]

Air-deliverable entanglement systems, directed energy, or EMP weaponry would significantly enhance maritime defense capabilities. Air-delivery of the system would enable rapid employment over long distances, overcoming the factors of time and space that dominate the maritime domain. Use of these non-lethal options would result in the suspect or threat vessel being dead in the water, after which boarding parties could perform their VBSS or law enforcement duties at their leisure.

In scenarios where intelligence reveals that an attack is in progress but not its origin or target, the military needs a rapid and flexible last-minute response capability. Non-specific intelligence makes maritime interdiction problematic since every ship becomes suspect. Without interdicting or inspecting every single vessel bound for the U.S., there would be no way of knowing which vessel was hostile. Modeling has demonstrated that if stowaway terrorists remain hidden until shortly before their attack, response time is limited to approximately 20 minutes.[264] Furthermore, without indicators to distinguish the attacking ship from others until endgame, VBSS teams are largely ineffective since there is inadequate time to deploy them. One solution to this problem is to use non-lethal shore batteries as a defense of last resort. If a ship came under hostile control as it entered the port, an in-place and on-call shore battery could respond in time to disable it.[265] While such a capability certainly is plausible, the cost (in terms of both money and manpower) of defending every port in the U.S. with a shore battery would be significant. At the very least, such a capability is years away.

Rather than waiting for development of a static defensive system using shore batteries, the military should consider using air power to provide a flexible response

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[263] Kopp.

[264] Kessler, *et al*, "Maritime Threat Response Project Outbrief."

[265] LCDR Andrew Kessler, *et al*, *Maritime Threat Response*, Final Report, 253.

capability. Aircraft on combat air patrol (CAP) could rapidly engage vessels that emerge as threats as they approach or enter U.S. ports. Aircraft CAPs are inherently flexible. Command authorities can stand them up or down and move them to different geographic locations as the threat dictates. Until non-lethal weapons are fielded, the 20-30mm cannon on most fighter/attack aircraft or the various caliber weapons on the AC-130 gunship could be used to disable last minute popup threats by targeting their bridges or engine rooms. Once non-lethal weapons are available, however, the best aircraft for their employment will likely be slow-movers, including either manned or unmanned helicopters and light aircraft. Thus, using fighters, bombers, or gunships for maritime defense CAP should only be seen as an interim solution until non-lethal weapons are fully mature.

4. Assess

The requirement to assess the effects from the engagement phase in maritime defense is the least complex of all F2T2EA steps. For maritime homeland defense, assessing simply requires ***a capability to evaluate whether or the engagement phase achieved its desired effects***. In most cases, the sensors used to fix, track, or engage the target vessel will also be able to perform this assessment. The fact that most sensors are coupled with their supported shooters makes assessment the least challenged step in the F2T2EA chain. Aircraft or surface/sub-surface vessels delivering ordnance can determine whether or not their attack destroyed or disabled a vessel. Boarding parties will know whether or not their efforts succeeded. Only in cases where long-range standoff weapons are used will as discreet assessment phase be required. In such cases, the sensors discussed in the fix/track section above should prove more than adequate.

C. ADDITIONAL CONSIDERATIONS

Prior to deciding whether or not to use air assets for maritime defense, the military needs to consider two significant operational issues. The first issue is how to affect command and control of airborne maritime defense assets. The second consideration is the cost of using air assets for maritime defense. These costs consist of both fiscal constraints as well as the hidden costs inherent in shifting military forces to new missions, including changes to training regimens, additional deployment costs, disruption to deployment schedules, and a potential for decreased force availability.

1. Command and Control of Airborne Maritime Defense Assets

The maritime homeland defense mission falls under the jurisdiction of U.S. Northern Command (NORTHCOM) and U.S. Pacific Command (PACOM). These combatant commands periodically conduct maritime exercises focused on terrorist threats. In 2002, U.S. Pacific Command and the Indonesian Navy focused their bi-lateral Cooperation and Readiness and Training Afloat (CARAT) exercise on counterterrorism.[266] Similarly, the 2004 Rim of the Pacific (RIMPAC) exercise conducted by the U.S. Third Fleet "enhanced international cooperation in fighting terrorism and drug smuggling."[267]

Despite these efforts, current maritime homeland defense capability exists largely on an *ad hoc* basis. NORTHCOM in particular has been the recipient of criticism for not devoting enough attention to the maritime mission.[268] The command does not have assigned naval forces, instead relying "on contingency planning for future events and theoretically acts as a coordinating bridge between the Navy and Coast Guard for Maritime Homeland Defense/Security issues."[269] Although the North American Regional Aerospace Defense Command (NORAD) agreement between the U.S. and Canada recently expanded to include a maritime surveillance role, NORAD "will not exercise operational control over maritime assets."[270] Furthermore, NORTHCOM currently does not equip any of its air defense fighters with air-to-surface ordnance.

To ensure clear lines of authority, combatant commanders should assign all forces performing the maritime defense mission to their Joint Forces Maritime Component Commander (JFMCC). Air Force doctrine already allows for the JFMCC to "plan and

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[266] Admiral Thomas Fargo, Commander, U.S. Pacific Command, Press Conference, Jakarta, Indonesia 15 August 2002, available from http://melbourne.usconsulate.gov/hyper/2002/0821/epf301.htm (accessed 18 August 2006).

[267] Hawaii Governor's Office, "Governor Thanks Participants in RIMPAC Maritime Exercise," press release, 30 July 2004, available from http://govarchive.hawaii.gov/gov/Members/candice/governor-newsletter/Members/candice/ governor-newsletter/Newsletter.2004-07-30 (accessed 18 August 2006).

[268] Roxana Tiron, "Northern Command Not Directing Enough Attention to Maritime Defense," *National Defense* 89, no. 614 (January 2005), 14.

[269] Carlos Urbizu, *Shielding Achilles' Heel: Challenges Facing Northern Command in the Maritime Domain*, Master's thesis (Monterey, California: Naval Postgraduate School, March 2004), 1.

[270] David Pugliese, "NORAD expands: Aerospace command takes on maritime surveillance role," *C4ISR: The Journal of Net-Centric Warfare*, online article, 3 July 2006, available from http://www.isrjournal.com/story.php?F=1854792 (accessed 18 August 2006).

direct limited Air Force support operations."[271] Putting all surface- and air-based maritime defense forces under the authority of a single component commander ensures a coordinated unity of effort during maritime interdiction missions. Importantly, one implication of this recommendation is that forces currently assigned to air defense (e.g., NOBLE EAGLE aircraft) should not be "dual-tasked" for both air- and maritime defense missions. Intelligence will drive differing operational requirements for air and maritime defense. Weapons loadouts and aircraft types required for these missions are different. Accordingly, separate forces should be assigned to each component for air and maritime defense.

2. Fiscal Constraints and Hidden Costs

Recommendations for resolving the capabilities gaps in the maritime defense F2T2EA kill chain should account for two different sets of constraints. First, fiscal constraints suggest a preference for low-cost innovations over technological or force structure fixes (e.g., increased numbers of troops or platforms) whenever possible. Second, capabilities-based planning must account for the hidden costs inherent in shifting military forces to new missions, including changes to training regimens, additional deployment costs, disruption to deployment schedules, and a potential for decreased force availability. With military forces spread thin by virtue of air defense requirements at home and worldwide deployments, these fiscal constraints and hidden costs may drive the services to oppose picking up a new mission. Indeed, the Air Force in the past has resisted moves to add air-to-surface missions to its fighter assets due to concerns over significantly increased operations tempo without appreciable homeland defense payoff.[272]

Upon close inspection, a significant increase in maritime defense capability results from only modest investments of current military assets. A limited number of long-range surveillance missions would be required for proscribed time periods (defined by intelligence and surface fleet availability) to find and track suspect vessels. Similarly, placing a single long-range bomber (and any required tanker support) on 24-hour alert status for maritime interdiction would ensure rapid, immediate, long-range firepower. In

[271] *AFDD 2-1.4*, 18.

[272] NORTHCOM J-5 official, interview with the author, July 2006.

both cases, these aircraft could operate out of there home bases, with no need to forward deploy to the coasts. If intelligence ever indicated an increase maritime threat, aircraft could be added to the alert packages.

A slightly larger investment is needed to provide maritime CAPs over U.S. ports as the last line of defense. While the number of times fighter/attack or gunship aircraft would be required on CAP is limited, additional training would be required for this mission. Aircrew would need to know the appropriate areas to target on large commercial vessels in order to disable them. Additionally, aircrew would need to maintain proficiency in air-to-surface gunnery. Placing fighter/attack or gunship aircraft (and required tanker support) on 24-hour alert status for combat air patrols over major ports would ensure minimal disruption to daily training schedules.

Over the long term, expanding and refining the military's maritime homeland defense capability will require additional resources. Investments in more robust intelligence capacity and the purchase of additional platforms such as various UAS, near-space platforms, the LCS, MH-60, and V-22 could put significant pressures on DoD's acquisition budget. Additionally, development, testing, and fielding of new non-lethal weapons, including entanglement devices, EMP weapons, and their delivery platforms will require additional funds. DoD leaders must understand that failing to provide for the acquisition of these resources will mean that the capability gaps discussed above will remain unresolved. If DoD decides to forego acquiring the capabilities recommended in this thesis, it must do so with full knowledge that it is accepting an increased risk with respect to maritime attacks on the homeland.

D. CONCLUSION

The speed, range, and flexibility of air power—whether land- or sea-based—gives it a clear role to play in overcoming the challenges inherent in the maritime homeland defense mission. Using an operational F2T2EA framework to examine the maritime homeland defense mission highlights the military capabilities required to accomplish each sequential step in the kill chain. Table 1 summarizes the current and required capabilities to find, fix, track, target, engage and assess maritime targets, as well as potential solutions for bridging the gaps between the two. Developing CONOPS for using air assets for maritime homeland defense, and providing the JFMCC with the

required aircraft for the mission, would make significant progress toward bridging existing gaps in military capability. With a relatively limited investment, the military could quickly field a rapid, long-range, and flexible response capability for maritime defense. To fully resolve the capabilities gaps will requires additional investment in new and existing technologies, including additional platforms and new non-lethal weapons. Failure to make this investment will only serve to perpetuate U.S. vulnerabilities to attacks on the homeland via the maritime domain.

	Maritime Homeland Defense Capability Requirement	Current Capabilities	Gaps	Proposed Gap Fillers
Find	Detect threat existence early enough to allow forces to fix, track, engage, and assess prior to it threatening the homeland.	Technical collection	Asymmetric threats	• HUMINT • COMINT • Fusion of current space-based and manned/unmanned systems into MDA • Near –space platforms
		MDA system	Ability for asymmetric threats to "blend in"	
		CBP programs	Ship-as-a-weapon scenario Infiltration scenario Non-participating ports State-based attackers	
Fix/Track	Geospatially locate the target over time with adequate fidelity for maritime interception and/or interdiction	Space-based assets	Limited availability Lack of persistence Inability to fix asymmetric threats	• Develop CONOPS for use of standoff air-breathing assets and sensors, particularly UAS such as Global Hawk and/or Predator • LCS delivery of boarding parties • LCS and helicopter delivery of boarding parties • V-22 delivery of boarding parties
		Air-breathing assets (manned and unmanned)	Lack of CONOPS Limited ability to fix asymmetric threats	
		Surface and sub-surface assets	Limited coverage area Limited ability to fix asymmetric threats	
		MDA system	Non-cooperative targets can evade	
Target/ Engage	Full-spectrum of response options, from minimal non-lethal force to the ability to disable or destroy a threat vessel	Boarding parties	Limited numbers Time required to arrive at suspect vessel	• Develop CONOPS for non-USN air power assets with rapid reach capability • LCS delivery of boarding parties • LCS and helicopter delivery of boarding parties • V-22 delivery of boarding parties • Develop non-lethal entanglement wpns • Develop non-lethal directed-energy wpns • Develop non-lethal EMP wpns
		Destructive force	Lack of CONOPS for non-USN assets Limited rapid reach of sub/surface vessels	
		Disabling force	No air-to-surface disabling weapons No surface-to-surface disabling weapons Precision air- or surface- gunfire option VBSS options	
		Rapid engagement	Lack of CONOPS for non-USN assets Excessive time enroute for sub/surface ships	
Assess	Evaluate whether or the engagement phase achieved its desired effects	Sensors coupled with shooter	See Fix/Track	• See Fix/Track

Table 1. F2T2EA Capability Summary

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V. CONCLUSION

A. SUMMARY OF FINDINGS

Several shortcomings hamper the U.S. military's current ability to perform maritime homeland defense. Gaps between current and required capabilities exist in every step of the find, fix, track, target, engage, and assess (F2T2EA) chain. When deciding which capabilities gap to address first, the Department of Defense (DoD) should consider which steps in F2T2EA have the largest capabilities gaps as these represent the military's weakest operational areas. Prioritizing capabilities improvements can then guide acquisition, doctrinal development, and operational planning.[273]

The most acute maritime defense capability gaps facing the military are in the fix and track steps of F2T2EA. A key requirement of the fix and track step is the ability to distinguish vessels posing an asymmetric threat from the large volume of legitimate maritime traffic. The second most significant capability shortfall facing the military is its limited ability to engage suspect vessels with non-lethal or disabling force. Without robust capability in this area, certain scenarios limit the military to two unpalatable options: applying lethal force or no force at all. The third largest capabilities gap is in the military's ability to find maritime defense threats. Improved performance in this area is required to ensure adequate warning of enemy operations and to enable subsequent step in the F2T2EA "kill chain."

Air power offers a potential means to narrow or bridge the capabilities gaps facing the military in each of these areas. This potential derives from the unique operational environment of the maritime domain. One of the main factors that hampers operations in the maritime realm is its size. This creates a need for speed, range, flexibility in any maritime defense force. These capabilities are inherent to air power. Thus, while naval surface and sub-surface forces are indispensable to resolving the maritime defense challenge, air power also has a role to play in efforts to find, fix, and finish the asymmetric enemy in the maritime domain.

[273] Davis, 13.

1. Air Power Enhancements to Fixing/Tracking

For the foreseeable future, the most effective means for distinguishing between friendly and hostile maritime traffic will be limited to DoD, Coast Guard, or other law enforcement agency boarding parties. To overcome the maritime domain's operational factors of time and space requires both rapid and long-range boarding party delivery capability. The Littoral Combat Ship (LCS) would significantly enhance this capability. Particularly promising is using the LCS to ferry boarding teams to within helicopter ranges and then using helicopters to deliver the team to the target vessel. Finally, the V-22 Osprey could also increase the time available for VBSS operations. Although adding this mission to the Osprey would require additional aircraft purchases, using V-22 aircraft would do much to overcome the factors of time and space which challenge the U.S. ability to rapidly fix the location of maritime homeland defense threats.

2. Air Power Enhancements to Engagement

In the limited scenarios where command authorities declared a vessel hostile (implying kill authority), aerial-refueled fighters, long-range bombers, or UAS platforms could provide rapid lethal response over the large distances inherent to the maritime realm. Still, the largest gaps in ability to target and engage maritime threats facing the U.S. military are the lack of non-lethal or ship-disabling weaponry. The first way to improve capability in this area is through faster delivery of boarding teams, since these teams are themselves a potentially non-lethal or ship-disabling weapon. Still, this represents an imperfect solution at best.

The most effective means of disabling a ship is to neutralize its propulsion or steering system. Accordingly, a small warhead kinetic weapon that homes on a ship's screws, engine room, or bridge would be an appropriate attack tool. AC-130 and fighter/attack aircraft employing strafe are the most immediately available option of this type. Similarly, using non-lethal entanglement, directed energy, or EMP weapons would quickly neutralize any potential maritime threat to the homeland without destroying the vessel, without compromising any evidence or intelligence on board, and without threatening the lives of noncombatants. Air-delivery of these systems would enable rapid employment over long distances.

In scenarios where intelligence indicates an attack is in progress without knowing either the specific target of the attack or its port of origin, Combat Air Patrols (CAP) provides a flexible response capability. Command authorities can stand a CAP up or down or move it to a different location as the threat dictates. Aircraft on CAP could rapidly engage vessels that emerge as threats as they approach or enter U.S. ports. Until non-lethal weapons are fielded, the 20-30mm cannon on most fighter/attack aircraft or the various caliber weapons on the AC-130 gunship could be used to disable threat vessels by targeting screws, bridges, or engine rooms. Once non-lethal weapons are available, the best aircraft for their employment will likely be slow-movers, including helicopters and light fixed-wing aircraft.

3. Air Power Enhancements to Finding

Unmanned aerial systems (UAS) possess the range, altitude and payload to make them potentially useful for finding maritime defense threats. For example, the RQ-4A Global Hawk can fly 1,200 miles and still have an on station time of 24 hours, during which the aircraft's synthetic aperture radar (SAR), electro-optical (EO), and infrared (IR) cameras "can image an area the size of Illinois."[274] Manned aircraft such as the U-2 or E-8 also offer a capability to find maritime defense threats. Short term, developing concepts and procedures for the use of air assets for sea surveillance offers a partial solution to the challenge of finding maritime defense threats. Longer term, the near-space platform offers significant benefits. Near-space platforms—usually some type of blimp or rigid airship—offer increased persistence over both space-based assets and UAS.

B. RECOMMENDATIONS

With military air forces spread thin by both air defense requirements at home and worldwide deployments, fiscal and hidden costs and other constraints may drive the services to resist picking up a new mission. Upon close inspection, however, a significant increase in maritime defense capability results from only modest investment of currents assets. Coupling these short-term actions with long-term investment in new weapons and platforms gives the military the opportunity to develop a robust maritime defense capability that capitalizes on air power's inherent speed, range, and flexibility.

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274 U.S. Air Force, *Global Hawk Fact Sheet.*

Three short-term actions would immediately enhance the military's ability to perform maritime defense. First, the combatant commands should develop concepts of operation (CONOPS) that incorporate the services various airborne assets into the maritime defense mission. These CONOPS must include assigning Navy, Marine, and Air Force aircraft to the Joint Forces Maritime Component Commander (JFMCC). The JFMCC can best ensure unity of effort for maritime defense by controlling all surface, sub-surface, and air assets involved in the mission.

Second, the services should provide the combatant commands with long-range surveillance and strike capability. Intelligence and surface fleet positioning would dictate when and for what duration combatant command required this capability. Given the present threat environment, these requirements would certainly be limited. Long-range manned and unmanned aircraft from the Air Force (e.g., U-2, E-8, and RQ-4) or Navy (e.g., P-3) would need to be assigned to the combatant commands only for proscribed time periods as intelligence dictated. Additionally, the services should place a single long-range strike aircraft (plus a spare and associated refueling support) on 12- to 24-hour alert status for maritime defense. Air Force B-1, B-52, or MQ-9 aircraft or a Navy P-3 would be appropriate. The ideal platform, however, is the AC-130 since it provides a less-lethal engagement option. Having strike aircraft immediately available to U.S. Northern Command (NORTHCOM) and Pacific Command (PACOM) would ensure rapid, long-range maritime interdiction capability. In most cases, long-range aircraft could sit alert from home base, with no need to forward deploy to the coasts.

Third, the services should provide the combatant commands with a maritime defense CAP capability. While the number of times fighter/attack or gunship aircraft would be required on CAP is limited, additional training would be required for this mission. Aircrew would need to know the appropriate areas to target on large commercial vessels in order to disable them. Additionally, aircrew would need to maintain proficiency in air-to-surface gunnery. Placing fighter/attack or gunship aircraft (and required tanker support) on 12- to 24-hour alert status for combat air patrols over major ports would ensure minimal disruption to daily training schedules.

To build increased effectiveness over the long term, the military should consider four investment opportunities. First, the joint force should develop, test, and evaluate employment plans for boarding teams that includes air, surface, and combined air/surface delivery options. Among ideas the military should consider is the use of the V-22 for long-range maritime insertions. Second, the development of non-lethal weapons—including entanglement devices, directed-energy, and EMP weapons—is imperative. Several scenarios demonstrate that without some type of non-lethal weapon, the military will not be able to defend the maritime domain against an asymmetric enemy. Third, the military should study the types of platforms that would be most appropriate for maritime defense. Slow-mover aircraft and helicopters—manned or unmanned—seem most desirable for performing maritime defense CAP. Finally, the military should invest in flexible and persistent sea surveillance capability. The near-space platform and other high-altitude, high-endurance unmanned systems seem most promising.

C. SUGGESTIONS FOR FUTURE RESEARCH

This thesis stepped through the first several steps of the capabilities-planning process and identified several promising short- and long-term actions for enhancing the military's maritime defense capability using air power. The next step in the process is to take these suggestions and refine them through war-gaming and simulation. This would enable the military to see the requirements and impacts of implementing the above recommendations in detailed form. Furthermore, this thesis focused (albeit not exclusively) on air power options for bridging capabilities gaps. Additional research could more accurately delineate surface and sub-surface options. Once again, exposing these options to robust war-gaming and simulation would reveal in detail the tradeoffs between the various approaches to maritime defense.

Technical assessments of the effectiveness of non-lethal weapons would do much to help clarify the most efficient and effective options for maritime defense. Studies that would be most useful to this effort include the utility (or futility) of employing entanglement devices against large ocean-going vessels, potential payoffs from directed energy weapons in the maritime domain, and the effectiveness of EMP weapons on commercial ships. Other topics for research include a study of the weapons effects of

medium-to-large caliber gunfire against the vulnerable areas of large vessels, and the feasibility and tradeoffs of various boarding party delivery methods. These would include ship, helicopter, V-22, and various hybrid delivery options.

D. CONCLUSION

A joint approach to maritime defense that incorporates air power offers the best possible protection of the homeland. Accordingly, the services need to start thinking about their respective roles in maritime defense now. In the short term, a networked force of surface, sub-surface, and air assets can blunt the maritime threat while maintaining economy of force. In the long term, the JFMCC needs to develop a detailed employment plan for boarding teams that includes air, surface, and combined air/surface delivery options. Innovative concepts of operation, such as use of the V-22 for long-range maritime insertions, could significantly enhance maritime defense. Similarly, innovative technological advances could make the joint force an even more effective guarantor of U.S. security. The development of non-lethal weapons is particularly important given the elusive nature of the enemy and the new operational environment. Combined with naval sea power, air power offers several opportunities to bridge the current capability gaps in maritime homeland defense.

BIBLIOGRAPHY

Abt, Clark C. *The Economic Impact of Nuclear terrorist Attacks on Freight Transport Systems in an Age of Seaport Vulnerability*. Cambridge, Massachusetts: Abt Associates for the U.S. Department of Transportation, 30 April 2003. Available from http://abtassociates.com/reports/ ES-Economic_Impact_of_Nuclear_Terrorist_ Attacks.pdf (accessed 14 March 2006).

Alexander, Yonah and Michael S. Swetnam. *Usama Bin Laden's Al-Qaida: Profile of a Terrorist Network*. Ardsley, New York: Transnational Publishers, 2001.

Arquilla, John and David Ronfeldt. "The Underside of Netwar." *Review—Institute of Public Affairs* 54, iss. 4 (December 2002).

Bartolomei, Jason, William Casebeer, and Troy Thomas. "Modeling Violent Non-State Actors: A Summary of Concepts and Methods." IITA Research Publication 4. United States Air Force Academy, Colorado: Institute for Information Technology Applications, November 2004.

Beizer, Doug. "DOD taps American Systems for nonlethal weapons work." GCN.com online article. 6 January 2006. Available from http://www.gcn.com/online/vol1_no1/37919-1.html?topic=defense-technology (accessed 15 September 2006).

Bell, J. Bowyer. "Revolutionary Dynamics: The Inherent Inefficiency of the Underground." *Terrorism and Political Violence* 2.

Bergen, Peter L. *Holy War, Inc: Inside the Secret World of Osama bin Laden.* New York: The Free Press, 2001.

Berger, Samuel R. "Foreign Policy for a Democratic President." *Foreign Affairs* 83, iss. 3 (May/June 2004).

Bethell, Ray and Barbara Bradley. "Hostile visit, board, search and seizure training 'takes down' the bad guys." *The Weaponeer*. 21 December 2000. Available from http://www.nawcwpns.navy.mil/~pacrange/s1/news/ 2000/Hostile.htm (accessed 15 June 2006).

Biddle, Stephen. *Afghanistan and the Future of Warfare: Implications for Army and Defense Policy*. Carlisle Barracks, Pennsylvania: U.S. Army War College Strategic Studies Institute, November 2002.

Bin Laden, Osama. "Eighth Al Qaeda Statement." 30 October 2004. Available from http://www.doublestandards.org/alqa.html (accessed 21 May 2006).

Blanchard, Christopher M. *Al Qaeda: Statements and Evolving Ideology*. CRS Report for Congress. RL32759. Washington, D.C: Library of Congress, updated 20 June 2005.

Bolkcom, Christopher. "Statement before the Senate Governmental Affairs Committee, Subcommittee on International Security, Proliferation, and Federal Services, Hearing on Cruise Missile Proliferation." 11 June 2002. Available from http://www.senate.gov/ ~gov_affairs/061102bolkcom.pdf (accessed 17 March 2006).

———. *V-22 Osprey Tilt-Rotor Aircraft*. CRS Issue Brief for Congress. IB86103. Washington, D.C: Library of Congress, updated 5 November 2001.

Bolkcom, Christopher and Sharon Squassoni. *Cruise Missile Proliferation*. CRS Report for Congress. Washington, D.C: Library of Congress, 3 July 2002.

Boyle, Alan. "Airship groomed for flight to edge of space: Developer says 'baby steps' will someday lead to orbit." MSNBC online article. 21 May 2004. Available from http://www.msnbc.msn.com/id/5025388/ (accessed 14 September 2006)

The Boston Globe. "One sunny April day near the LNG tank, a close call on Mystic: A 600-foot ship overshoots dock, and charges fly." Online article. 7 May 2006. Available from http://www.boston.com/news/local/articles/2006/05/07/one_sunny_april_day_near_the_lng_tank_a_close_call_on_mystic/ (accessed 21 July 2006).

Bourston, Jack. "Assessing Al Qaeda's WMD Capabilities." *Strategic Insights* 1, no. 7. Available from http://www.ccc.nps.navy.mil/rsepResources/si/sept02/wmd.asp#references (accessed 17 March 2006).

Bragadin, Marc Antonio. *The Italian Navy in World War II*. Trans. Gale Hoffman. Washington, D.C: United States Naval Institute, 1957.

Brown, David. *The Road to Oran: Anglo-French Naval Relations September 1939-July 1940*. London: Frank Cass, 2004.

Chipman, Donald D. and Major David Lay. "Sea Power and the B-52 Stratofortress." *Air University Review* (January-February 1986).

Clark, Vern. "Sea Power 21 Series—Part I: Projecting Decisive Joint Capabilities." United States Naval Institute *Proceedings*. October 2002. Available from http://www.usni.org/ Proceedings/ Articles02/PROcno10.htm (accessed 18 May 2006).

Clarke, Richard A. *Against All Enemies: Inside America's War on Terror*. New York: Free Press, 2004.

Frank Colucci, "Navy, Marine Helicopter Fleets Will See Steady Arrivals of New Aircraft." *National Defense*. Online edition. September 2005. Available from http://www.nationaldefensemagazine.org/issues/2005/Sep/Navy_Marine.htm (accessed 15 September 2006).

Covault, Craig. "Secret NRO Recons Eye Iraqi Threats." *Aviation Week & Space Technology* 157, iss. 12.

Crenshaw, Martha. "The Causes of Terrorism." *Comparative Politics* 13, no. 4.

Cressman, Robert J., Steve Ewing, Barrett Tillman, Mark Horan, Clark Reynolds and Stan Cohen. *A Glorious Page in Our History: The Battle of Midway, 4-6 June 1942*. Missoula, Montana: Pictorial Histories Publishing Company, 1990.

Dardine, Andrew. "Avionics in Demand." *Aviation Week & Space Technology* 164, iss. 3.

Davis, Paul K. *Analytic Architecture for Capabilities-Based Planning, Mission-System Analysis, and Transformation*. Santa Monica, California: RAND Corporation, 2002.

Dobbs, Michael. "Homeland Security …From the Sea." *RUSI Journal* 147, no. 4.

Don Levine, Isaac. *Mitchell: Pioneer of Airpower*. New York: Duel, Sloan and Pearce, 1943.

Donnelly, Thomas and Michael Vickers. *Iraq: Lessons Learned*. American Enterprise Institute. 8 December 2003. Available from http://www.aei.org/events/ filter.,eventID.337/summary.asp (accessed 4 December 2005).

Falk, Ophir and Yaron Schwartz. "Terror at Sea: The Maritime Threat." Herzliya, Israel: Institute for Counterterrorism, 25 April 2005. Available from http://www.ict.org.il/ articles/ articledet.cfm?articleid=532 (accessed 16 March 2006).

Fargo, Thomas. "Commander, U.S. Pacific Command, Press Conference." Jakarta, Indonesia, 15 August 2002. Available from http://melbourne.usconsulate.gov/hyper/ 2002/0821/epf301.htm (accessed 18 August 2006).

FAS.org. *AC-130H Spectre/AC-130U Spooky Fact Sheet*. 8 January 2000. Available from http://www.fas.org/man/dod-101/sys/ac/ac-130.htm (accessed 15 September 2006).

———. *AGM-84 Harpoon Fact Sheet*. 1 December 2005. Available from http://www.fas.org/man/dod-101/sys/smart/agm-84.htm (accessed 18 August 2006).

———. *SENIOR YEAR / AQUATONE / U-2 / TR-1 Fact Sheet*. Available from http://www.fas.org/irp/program/collect/u-2.htm (accessed 18 August 2006).

Friedman, Norman. *The US Maritime Strategy*. New York: Jane's, 1988.

Fritelli, John F. *Port and Maritime Security: Background and Issues for Congress*. CRS Report for Congress. RL 31733. Washington, D.C: Library of Congress, 27 May 2005.

Fulghum, David A. "Sensor Success." *Aviation Week & Space Technology* 162, iss. 21.

Gertz, Bill. "North Korea, Al Qaeda Union a Threat." *Washington Times*, 1 April 2004. Available from http://www.washtimes.com/national/20040331-105348-4826r.htm (accessed 1 December 2005).

Global Security.org. *Global Hawk (Tier II+ HAE UAV) Fact Sheet*. Available from http:// www.globalsecurity.org /intell/systems/global_hawk.htm (accessed 4 December 2005).

———. *MQ-9A Predator B Fact Sheet*. Available from http://www.globalsecurity.org/ intell/systems/predatorb.htm (accessed 4 December 2005).

———. *P-3 Orion Fact Sheet*. Available from http://www.globalsecurity.org/ military/systems/aircraft/p-3.htm (accessed 18 August 2006), and

———. *P-8 Multimission Maritime Aircraft (MMA) Broad Area Maritime Surveillance Fact Sheet*. Available from http://www.globalsecurity.org/ military/systems/aircraft/mma.htm (accessed 18 August 2006).

———. *RQ-1Medium Altitude Endurance (MAE) UAV Fact Sheet*. Available from http://www.globalsecurity.org/intell/systems/predator.htm (accessed 4 December 2005).

Goss, Thomas J. *Building a Contingency Menu: Using Capabilities-based Planning for Homeland Defense and Homeland Security*. Master's thesis. Monterey, California: Naval Postgraduate School, March 2005.

Hallion, Richard P. "Air Warfare and Maritime Defense." Paper number 45. Fairbairn, Australia: Air Power Studies Center, Royal Australian Air Force, June 1996.

———. "Air Power and Asymmetric Threats." Remarks to the Royal Australian Air Force 2000 Air Power Conference. Available from http://www.raaf.gov.au/airpower/ publications/conferences/ 2000/hallion.pdf (accessed 7 March 2006).

Hamer, David. *Bombers Versus Battleships: The struggle between Ships and Aircraft for the Control of the Surface of the Sea*. Annapolis, Maryland: Naval Institute Press, 1998.

Hawaii Governor's Office. "Governor Thanks Participants in RIMPAC Maritime Exercise." Press release. 30 July 2004. Available from http://govarchive.hawaii.gov/gov/Members/ candice/governor-newsletter/Members/candice/ governor-newsletter/Newsletter.2004-07-30 (accessed 18 August 2006).

Heuer, Richards. *The Psychology of Intelligence Analysis*. Washington, D.C: Central Intelligence Agency and Center for the Study of Intelligence, 1999. Available from https://www.cia.gov/ csi/Psychology/PsychofIntelNew.pdf (accessed 27 July 2006).

Hezlett, Arthur. *Aircraft and Sea Power*. New York: Stein and Day, 1970.

Hightower, Mike, Louis Gritzo, Anay Luketa-Hanlin, John Covan, Sheldon Tieszen, Gerry Wellman, Mike Irwin, Mike Kaneshige, Brian Melof, Charles Morrow, and Don Ragland. *Guidance on Risk Analysis and Safety mplications of a Large Liquefied Natural as (LNG) Spill Over Water*. Albuquerque, New Mexico: Sandia National Laboratories, December 2004. Available from http://www.fossil.energy.gov/programs/oilgas/storage/ lng/sandia_lng_1204.pdf (accessed 21 July 2006).

Hooton, E. R. ed. *Jane's Naval Weapon Systems* 44. 2006.

Howard, Russell D. and Reid Sawyer, eds. *Terrorism and Counterterrorism: Understanding the New Security Environment, Readings and Interpretations*. New York: McGraw Hill, 2003.

Hurley, Alfred F. *Billy Mitchell Crusader for Air Power*. New York: Franklin Watts, 1964.

Isenberg, David. "The Real Missile Threat: Cruise, non Ballistic." Washington, D.C. Center for Defense Information, 8 July 2002. Available from http://www.cdi.org/ terrorism/cruise-pr.cfm (accessed 17 March 2006).

Janis, Irving L. and Leon Mann. *Decision Making: A Psychological Analysis of Conflict, Choice, and Commitment*. New York: Free Press, 1977.

Johnson, Stuart, Martin Libicki, and Gregory F. Treverton, eds. *New Challenges, New Tools for Defense Decisionmaking*. Santa Monica, California: RAND Corporation, 2003.

Kaplan, Eban. "Liquefied Natural Gas: A Potential Terrorist Target?" Council on Foreign Relations. Online article. 27 February 2006. Available from http://www.cfr.org/ ublication/9810/liquefied_natural_gas.html (accessed 21 July 2006).

Keebaugh, Tonya. "Resultant Fury Successful Thanks to 'Test' Airmen." *Air Force Print News*, 14 December 2004. Available from http://www.af.mil/news/story_print.asp? storyID=123009411 (accessed 4 December 2005).

Kessler, Andrew, Michael Shewfelt, Jennifer Davis, Brian Connett, Jared Chiu-Rourman, Joseph Oravec, and Shaunnah Wark. *Maritime Threat Response*. Final Report. Monterey, California: Naval Postgraduate School, June 2006.

———. "Maritime Defense Threat Response Project Out-brief." Monterey, California: Naval Postgraduate School, 24 May 2006.

Kopp, Carlo. "The Electromagnetic Bomb - a Weapon of Electrical Mass Destruction." *Air & Space Power Journal - Chronicles Online Journal*. 1995-1998. Available from http://www.airpower.maxwell.af.mil/ airchronicles/kopp/apjemp.html (accessed 15 September 2006).

Kreisher, Otto. "Two S.D. firms could be competing for Navy contract: BAMS is called huge undertaking." *San Diego Union-Tribune*. Online article. 18 May 2006. Available from http://www.signonsandiego.com/uniontrib/20060518/news_1b18bams.html (accessed 18 August 2006).

Laite, B. C. *Maritime Air Operations*. London: Brassey's, 1991.

Lavoy, Peter R. and Scott D. Sagan and James J. Wirtz, eds. *Planning the Unthinkable: How New Powers will use Nuclear, Biological, and Chemical Weapons*. Ithaca, New York: Cornell University Press, 2000.

Lawlor, Maryann. "Maritime Defense Undergoes all-Hands Evolution." *Signal* 58, no. 3 (November 2003).

Layman, R. D. *Before the Aircraft Carrier: The Development of Aviation Vessels, 1849-1922*. London: Conway Maritime Press, Ltd., 1989.

Leader, Stephan. "Osama Bin Laden and the Terrorist Search for WMD." *Jane's Intelligence Review* 11, no. 6 (June 1999).

Ian O. Lesser. "Coalition Dynamics in the War against Terrorism." *The International Spectator*. February 2002. Available from http://pacificcouncil.org/pdfs/lesser.pdf (accessed 18 August 2005).

Levine, Isaac Don. *Mitchell: Pioneer of Airpower*. New York: Duel, Sloan and Pearce, 1943.

Loury, Thomas P. and John Wellam. *The Attack on Taranto: Blueprint for Pearl Harbor*. Mechanicsburg, Pennsylvania: Stackpole Books, 1995.

Love, Robert W.,Jr. *History of the US Navy, Volume II*. Harrisburg, Pennsylvania: Stackpole Books, 1992.

Lynch, Colum. "Bin Laden Sought Uranium, Jury Told; Material Said to be from South Africa Offered for $1.5 Million, Ex-Associate Testifies." *The Washington Post*. 8 February 2001.

Maranda, Clare. "Maritime Intelligence Fusion Center opened." *Pacific Tides*. Online edition. U.S. Coast Guard, 1 November 2003. Available from http://www.uscg.mil/pacarea/news/ptol/features/MaritimeFusion/ (accessed 14 September 2006).

"Maritime Boarding SEAL Style." Online article. Available from http://www.specwarnet.net/miscinfo/ SEALboard.htm (accessed 15 June 2006).

Maritime Domain Awareness Remote Sensing Symposium and Regional Data Exchange Conference. "Maritime Security Breakout Session." Slide presentation. Rochester, New York: April 2006. Available from http://rdx.glc.org/06/presentations/ LES_2_Robbins.ppt (accessed 2 October 2006).

Maritime Security Policy Coordinating Committee. *Maritime Operational Threat Response for the National Strategy for Maritime Security*. Washington, D.C: National Security Council/Homeland Security Council, October 2005.

McCarter, Mickey. "B-52 Transformation: Keeping the most versatile bomber in the fleet fresh for the next 37 years." *Military Aerospace Technology* 2, iss. 4. Online edition (15 September 2003). Available from http://www.military-aerospace-technology.com/article.cfm?DocID=192 (accessed 13 September 2006).

McCormick, Gordon H. "Terrorist Decision Making." *Annual Review of Political Science* 6.

Means, C. Don, Erika Darling, and Janet Perron. "Applying Cognitive Work Analysis to Time Critical Targeting Functionality." MITRE Technical Report MTR 04B0000057. Bedford, Massachusetts: MITRE Corporation, October 2004. Available from http://www.mitre.org/work/tech_papers/tech_papers_04/ 04_0962/04_0962.pdf (accessed 15 June 2006).

Middlebrook, Martin. *Operation Corporate: The Falklands War 1982*. New York: Viking, 1985.

Middle East Media Research Institute (MEMRI). "Why We Fight America: Al-Qa'ida Spokesman Explains September 11 and Declares Intentions to Kill 4 Million American with Weapons of Mass Destruction." *MEMRI Special Dispatch*, no. 388. Available from http://memri.org/bin/ opener.cgi ?Page=archives&ID=SP38802 (accessed 30 November 2005).

Nasr, Vali. Lecture on Islamic Fundamentalism. Naval Postgraduate School. 25 May 2006.

National Intelligence Council. Central Intelligence Agency. *Global Trends 2015: A Dialogue About the Future with Non-government Experts*. Washington, D.C: Central Intelligence Agency, December 2000. Available from http://www.odci.gov/nic/ PDF_GIF_global/ globaltrend2015.pdf (accessed 17 March 2006).

New York Times. "50 Years Later, Texas Town Recalls Horrors of Deadly Blast." East Coast late edition. 16 April 1997.

NORTHCOM J-5 official. Interview with the author. July 2006.

Office of Homeland Security. *National Strategy for Homeland Security*. Washington, D.C: The White House, July 2002.

Olds, Kiley. "Dyess AFB Demonstrates B-1B's Upgrades, Combat Capabilities." *Air Force Print News*, 19 August 2005. Available from http://www.af.mil/news/story_print.asp? storyID=123011369 (accessed 4 December 2005).

O'Rourke, Ronald. *Navy Littoral Combat Ship (LCS): Background and Issues for Congress*. CRS Report to Congress. RS21305. Washington, D.C: Library of Congress, updated 18 August 2006.

Pape, Robert A. *Dying to Win: The Strategic Logic of Suicide Terrorism*. New York: Random House, 2005.

Pardesi, Manjeet Singh. "Unmanned Aerial Vehicles/Unmanned Combat Aerial Vehicles: Likely Missions and Challenges for the Policy-Relevant Future." *Air and Space Power Journal* XIX, no. 3.

President of the United States. *The National Security Strategy of the United States of America*. Washington, DC: The White House, September 2002.

———. "Homeland Security Presidential Directive HSPD-13: Maritime Security Policy." 21 December 2004. Available from http://www.fas.org/irp/offdocs/nspd/nspd41.pdf (accessed 17 March 2006).

Pugliese, David. "NORAD expands: Aerospace command takes on maritime surveillance role." *C4ISR: The Journal of Net-Centric Warfare*. Online article. 3 July 2006. Available from http://www.isrjournal.com/story.php?F=1854792 (accessed 18 August 2006).

Ransom, Harry H. "The Battleship Meets the Airplane." *Military Affairs* 23, no. 1 (Spring 1959).

Reisdorff, Nicholas R. *Winning the Hundred Battles: China and Asymettric Warfare*. Master's Thesis. Fort Leavenworth, Kansas: U.S. Army Command and General Staff College, 2003.

Ricks, Thomas E. and Peter Slevin. "Spain and U.S. Seize N. Korean Missiles: Scuds Were on Ship Bound for Yemen." *Washington Post*. 11 December 2002.

Robinson, Douglass A. *Giants in the Sky: A History of the Rigid Airship*. Seattle: University of Washington Press, 1973.

Ross, Brian and Richard Esposito. "Surge in Sale of Disposable Cell Phones May Have Terror Link." ABC News Investigations. Online article. 12 January 2006. Available from http://abcnews.go.com/WNT/Investigation/story?id=1499905 (accessed 14 September 2006).

Russell, James and Illiana Bravo. "Homeland Defense: Ramping Up, But What's the Glidepath." *Strategic Insights* I, iss. 1 (March 2002). Available from http://www.ccc.nps.navy.mil/si/ mar02/homeDefense.asp (accessed 17 March 2006).

Rhys-Jones, Graham. *The Loss of the Bismarck: An Avoidable Disaster*. Annapolis, Maryland: Naval Institute Press, 1999.

Sageman, Marc. *Understanding Terror Networks*. Philadelphia. University of Pennsylvania Press, 2004.

Saunders, Hilary St. George. *The Rise of British Air Power, 1911-1939.* London: Oxford University Press, 1945.

Scott, William B. "Nowhere To Hide." *Aviation Week & Space Technology* 161, Iss. 13.

Shafer, Jack. "Don't Blame the *Washington Times* For the Osama Bin Laden satellite phone 'leak.'" *Slate* online magazine. 21 December 2005. Available from http://www.slate.com/id/2132975/ (accessed 14 September 2006).

Shapiro, Jacob N. "Organizing Terror: Hierarchy and Networks in Covert Organizations." Draft paper. Stanford University. 1 November 2005.

Sherman, Mark. "Coast Guard, FBI tension threatens response to sea-based terrorism, Justice watchdog says." *The Boston Globe*. Online article. 3 April 2006. Available from http://www.boston.com/news/local/connecticut/articles/2006/ 04/03/ report_conflicts_threaten_response_to_sea_based_terrorism/?rss_id=Boston.com+ %2F+News+%2F+Local (accessed 18 May 2006).

Sikorsky SH-60 Seahawk Fact Sheet. Available from http://www.answers.com/topic/ sikorsky-sh-60-seahawk (accessed 15 September 2006).

Space Daily. "Ground Moving Target Engagement System Hits Tank with JDAM." 22 December 2003. Available from http://www.spacedaily.com/news/gps-03zzh.html (accessed 4 December 2005).

Streetly, Martin, ed. *Jane's Radar and Electonic Warfare Systems 2005-2006*. 17th ed. Alexandria, Virginia: Jane's Information Group, 2005.

Swartz, Peter M., Jan S. Breemer, and James John Tritten. *The Maritime Strategy Debates: A Guide to the Renaissance of U.S. Naval Strategic in the 1980s*. Revised ed. Monterey, California: Naval Postgraduate School, 1989.

Tangredi, Sam J. ed. *Globalization and Maritime Power*. Washington, D.C: National Defense University Press, 2002.

Tedder, Richard. *Air Power in War*. London: Hodder and Stoughton, 1957.

Tenet, George J. "Worldwide Threat - Converging Dangers in a Post 9/11 World." Testimony of the Director of Central Intelligence before the Senate Armed Services Committee. 19 March 2002. Available from http://www.cia.gov/cia/public_affairs/speeches/2002/senate_select_hearing_03192002.html (accessed 17 March 2006).

Texas State Historical Association. "Texas City Disaster." *Handbook of Texas Online*. Texas State Historical Association and the University of Texas, 6 June 2001. Available from http://www.tsha.utexas.edu/ handbook/online/articles/TT/lyt1.html (accessed 14 March 2006).

Thomas, Guy. "A Maritime Traffic-Tracking System: Cornerstone of Maritime Homeland Defense." *Naval War College Review* 56, no. 4 (Autumn 2003).

Thomas, Timothy L. "Chinese and American Network Warfare." *Joint Forces Quarterly*, iss. 38 (3rd quarter 2005).

Till, Geoffrey. *Maritime Strategy and the Nuclear Age*, 2nd ed. New York: St. Martin's Press, 1984.

Tiron, Roxana. "Northern Command Not Directing Enough Attention to Maritime Defense." *National Defense* 89, no. 614.

Tirpak, John A. "Find, Fix, Track, Target, Engage, Assess." *Air Force Magazine* 83, no. 7.

Tomme, Ed, and Sigfred Dahl. "Balloons in Today's Military? An Introduction to the Near Space Concept" *Air and Space Power Journal* XIX, no. 4.

"Two bombers participating." *Aviation Week & Space Technology* 164, iss. 20.

Traffic World. "Chinese Stowaways Caught in Seattle." 24 April 2006.

Tse-Tung, Mao. *On Guerrilla Warfare*. Samuel B. Griffith, trans. Baltimore, Maryland: Nautical and Aviation Publishing Company of America, 1992.

Tyler, Patrick E. "Qaeda Suspect was Taking Flight Training Last Month." *New York Times*. Late East Coast edition, 23 December 2002.

Tzu, Sun. *The Art of Warfare*. Trans. Roger Ames. New York: Ballantine, 1993.

Urbizu, Carlos. *Shielding Achilles' Heel: Challenges Facing Northern Command in the Maritime Domain*. Master's thesis. Monterey, California: Naval Postgraduate School, March 2004.

United Nations. "Charter of the United Nations – Chapter 7: Action with Respect to Threats to the Peace, Breaches of the Peace, and Acts of Aggression." Available from http://www.un.org/aboutun/ charter (accessed 29 May 2006).

———. "United Nations Convention on the Law of the Sea." Available from http://www.un.org/ Depts/los/ convention_agreements/texts/unclos/closindx.htm, accessed 25 May 2006.

———. Division of Ocean Affair and Law of the Sea. "Status of the United Nations Convention on the Law of the Sea,"28 April 2006, available from http://www.un.org/Depts/los/reference_files/status2006.pdf (accessed 25 May 2006).

United States Air Force. *AC-130H/U Gunship Fact Sheet*. October 2005. Available from http://www.af.mil/ factsheets/factsheet.asp?fsID=71 (accessed 15 September 2006).

———. *Air Force Doctrine Document 1: Air Force Basic Doctrine*. Washington, D.C: U.S. Air Force, 17 November 2003. Available from http://www.e-publishing.af.mil/ pubfiles/af/dd/afdd1/afdd1.pdf (accessed 10 March 2006).

———. *Air Force Doctrine Document 2-1.4: Countersea Operations*. Washington, D.C: U.S. Air Force, 15 September 2005. Available from www.e-publishing.af.mil/ pubfiles/af/dd/afdd2-1.4/afdd2-1.4.pdf (accessed 10 March 2006).

———. *AGM-65 Fact Sheet*. October 2005. Available from http://www.af.mil/factsheets/ factsheet.asp?fsID=72 (accessed 17 March 2006).

———. *Global Hawk Fact Sheet*. October 2005. Available from http://www.af.mil/ factsheets/ factsheet.asp?fsID=175 (accessed 4 December 2005).

———. *MH-53J/M Pave Low Fact Sheet*. October 2005. Available from http://www.af.mil/factsheets/factsheet.asp?id=117 (accessed 4 December 2005).

———. *MQ-1Predator Unmanned Aerial Vehicle Fact Sheet*, October 2005, available from http://www.af.mil/factsheets/factsheet_print.asp?fsID=122&page=1 (accessed 17 March 2006).

United States Coast Guard. *High Altitude Endurance Unmanned Air Vehicle (HAEUAV) Fact Sheet*. 2 February 2006. Available from http://www.uscg.mil/deepwater/system /hauav.htm (accessed 18 August 2006).

———. *National Plan to Achieve Maritime Domain Awareness*. Washington, D.C: Department of Homeland Security, October 2005.

———. "Non-Lethal Weapons in Law Enforcement Briefing." Washington, D.C: U.S. Coast Guard, 2002. Available from www.dtic.mil/ndia/2002nonlethdef/Jacobs.pdf (accessed 15 September 2006).

United States Department of Defense. *Investigation Report: Formal Investigation into the Circumstances Surrounding the Downing of Iran Air Flight 655 on 3 July 1988*. Washington, D.C: Department of Defense, 1988.

———. *Department of Defense Directive (DODD) 5100.1: Functions of the Department of Defense and Its Major Components*. Washington, D.C: Department of Defense, 1 August 2002. Available from http://www.dtic.mil/whs/directives/corres/html2/ d51001x.htm (accessed 10 March 2006).

———. *Department of Defense Homeland Security Joint Operating Concept*. Washington, D.C: Department of Defense, February 2004.

———. *Joint Operations Concepts*. Washington, D.C: Department of Defense, November 2003.

———. *Joint Publication 1-02: Department of Defense Dictionary of Military and Associated Terms*. Washington, D.C: U.S. Department of Defense, 14 April 2006.

———. *Quadrennial Defense Review Report*. Washington, D.C: Department of Defense, 2001.

———. *The National Defense Strategy of the United States of America*. Washington, DC: Department of Defense, March 2005.

———. *Strategy for Homeland Defense and Civil Support*. Washington, DC: Department of Defense, June 2005.

United States Department of Homeland Security. U.S. Customs and Borders Protection. "Securing U.S. Ports." Fact Sheet. 12 July 2006. Available from http://www.cbp.gov/xp/cgov/newsroom/fact_sheets/ port_security/securing_us_ports.xml (accessed 17 August 2006).

U.S. Department of Homeland Security. *The National Strategy for Maritime Security*. Washington, DC: Department of Homeland Security, September 2005.

———. *National Plan to Achieve Maritime Domain Awareness for the National Strategy for Maritime Security*. Washington, D.C: Department of Homeland Security, October 2005.

United States Department of Justice. Audit Division. Office of the Inspector General. *The Federal Bureau of Investigation's Efforts to Protect the Nation's Seaports*. Audit Report 06-26. March 2006. Available from http://www.usdoj.gov/oig/reports/FBI/ a0626/final.pdf (accessed 18 May 2006).

United States Department of State. Counterterrorism Office. "State Sponsors of Terrorism." Available from http://www.state.gov/s/ct/c14151.htm(accessed 2 December 2005).

———. Bureau of Nonproliferation. *The Proliferation Security Initiative: Statement of Interdiction Principles*. 28 July 2004. Available from http://www.state.gov/t/ np/rls/other/ 34726.htm (accessed 30 November 2005).

———. Office of the Spokesman. *Singapore Hosts Proliferation Security Initiative (PSI) Interdiction Exercise (DEEP SABRE)*. Media Note. 12 August 2005. Available from http://www.state.gov/r/pa/ prs/ps/2005/51032.htm (accessed 18 May 2006).

United States Department of Transportation. *An Assessment of the U.S. Marine Transportation System: A Report to Congress*. Washington, D.C: U.S. Department of Transportation, September 1999. Available from http://www.marad.dot.gov/ publications/ MTSreport/mtsfinal.pdf (accessed 16 March 2006).

United States General Accounting Office. "Cruise Missile Defense: Progress Made but Significant Challenges Remain." Report to the Chairman, Subcommittee on Military Research and Development, Committee on Armed Services, House of Representatives, March 1999. Available from http://www.gao.gov/archive/1999/ ns99068.pdf (accessed 17 March 2006).

United States House of Representatives. Subcommittee on Coast Guard and Maritime Transportation. Resources Committee. "Hearing on Coast Guard Law Enforcement." 15 June 2005. Available from http://resourcescommittee.house.gov/transportation/ cgmt/06-15-05/06-15-05memo.html (accessed 18 May 2006).

———. "Hearing on Maritime Domain Awareness." 6 October 2004. Available from http://www.house.gov/transportation/cgmt/10-06-04/10-06-04memo.html (accessed 14 September 2006).

United States Joint Chiefs of Staff. *Joint Pub 2-01: Joint and National Intelligence Support to Military Operations*. Washington, D.C: Joint Chiefs of Staff, 7 October 2004. Available from http://www.dtic.mil/doctrine/jel/new_pubs/jp2_01print.pdf (accessed 4 December 2005).

———. *National Military Strategy of the United States of America: A Strategy for Today; a Vision for Tomorrow*. Washington, D.C: Joint Chiefs of Staff, 2004.

United States Marine Corps. *V-22 Osprey Fact Sheet*. 30 December 1997. Available from http://www.hqmc.usmc.mil/factfile.nsf/0/006111164d72c407852562de00720540?OpenDocument (accessed 15 September 2006).

United States Naval Institute. *The Maritime Strategy*. Annapolis, Maryland: U.S. Naval Institute, 1986.

United States Navy. *From the Sea*: *Preparing the Naval Service for the 21st Century*. Washington, D.C: U.S. Navy, September 1992. Available from http://www.chinfo.navy.mil/navpalib/policy/ fromsea/fromsea.txt (accessed 17 March 2006).

United States Navy. *Naval Aviation Vision 2020*. Washington, D.C: U.S. Department of the Navy, no date.

United States Navy. Naval Historical Center. "Preparations for Battle, March 1942 to 4 June 1942 – Overview." Available from http://www.history.navy.mil/photos/events/wwii-pac/midway/mid-1m.htm (accessed 10 March 2006).

United States Navy. Naval Sea Systems Command. DC Museum. "USS Stark." Online article. Available from http://www.dcfp.navy.mil/mc/museum/STARK/Stark3.htm (accessed 21 July 2006).

———. "Dynamic Lift Vehicles." Online directory. Available from http://www50.dt.navy.mil/ toc.html (accessed 15 September 2006).

United States Navy. Office of Naval Intelligence. National Maritime Intelligence Center. "Our Mission." Fact Sheet. Available from http://www.nmic.navy.mil/mission.htm (accessed 14 September 2006).

Walker, Roy and Larry Ridolfi. "Airpower's Role in Maritime Operations." *Air and Space Power Chronicles* [online journal]. Available from http://www.airpower.maxwell.af.mil/airchronicles/ cc/ridolfi.html (accessed 23 February 2006).

Wall, Robert. "F/A-18E/F Radar Upgrade Readied." *Aviation Week & Space Technology* 157, iss. 26.

Watts, R.B. "Fight Them Forward." *Strategic Insights* IV, iss. 7 (July 2005). Available from http://www.ccc.nps.navy.mil/si/2005/Jul/wattsJul05.pdf (accessed 17 March 2006).

Weber, Christian. *New York State Office of Homeland Security Focus Report: Maritime Terrorist Threat*. New York: New York State Office of Homeland Security. 21 February 2006.

Weimann, Gabriel. *Terror on the Internet: The New Arena, the New Challenges*. Washington, D.C: The United States Institute for Peace, 2006.

The White House. *National Strategy for Combating Terrorism*. Washington, D.C: The White House. February 2003.

Winklareth, Robert J. *The Bismarck Chase: New Light on a Famous Engagement*. Annapolis, Maryland: Naval Institute Press, 1998.

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